NOVEMBER 1960

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Electrical South

Floor cable proves practical method of heating a church

See page 24

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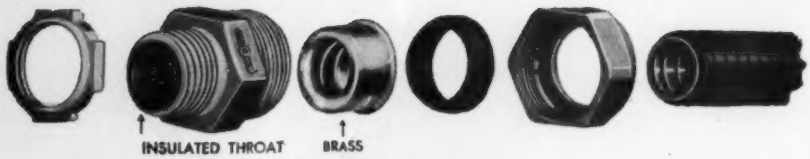

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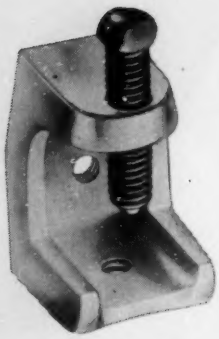

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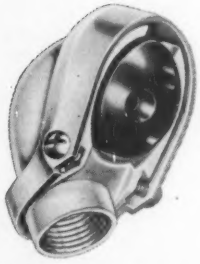

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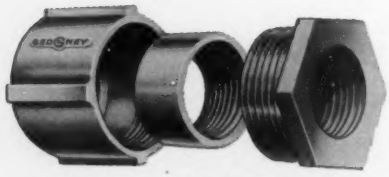

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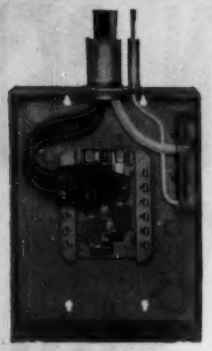

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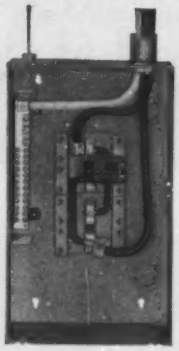

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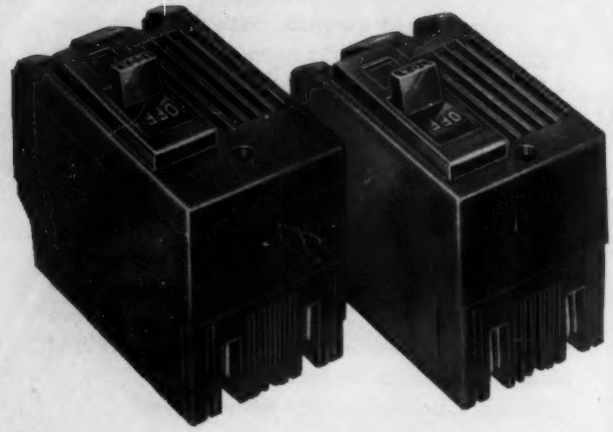

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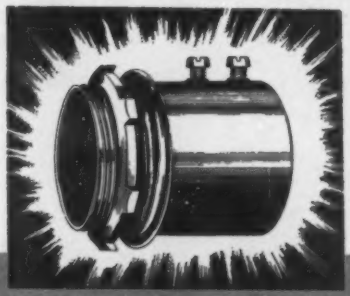

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Economic comment

by J. Whitney Bunting, Ph.D.
Contributing Economics Editor

Analyzing today's economic problems

The American people have extreme difficulty in analyzing economic statistics to show just how, and how far, the economy is progressing. This is not surprising, for not only do the facts themselves confuse the issues, but the way such facts are interpreted by "experts" creates even greater variances.

The situation becomes doubly difficult during the heat of a presidential election campaign when opposing candidates (speaking of such economic facts as unemployment, economic growth, inflation, and many others) come up with different statistics and draw widely divergent conclusions even when the basic figures are identical.

It is entirely possible to interpret facts in different lights, but this creates serious problems to the average citizen who is forced, with inadequate economic knowledge, to vote for one candidate or another on the basis of such views, often erroneous in fact.

Two problem areas can serve to illustrate the moral of this statement—employment and economic growth.

Reports from Washington showed that in September of this year there were more jobs in existence than in any previous September in history. This fact would certainly tend to indicate that the United States was surely in one of the most prosperous eras in history.

Yet another business statistic might well dampen the enthusiasm for this conclusion. Personal income, although also at an extremely high level, was not expanding as rapidly as the number of jobs available. Does this mean that the average salary level is declining in spite of the increase in jobs?

A review of all aspects of this condition will promptly show that in recent weeks there has been a decline in the number of hours worked per week, particularly in the field of manufacturing. Does this create a serious trend or a dangerous economic situation? The answer is "no" for the present, at least, although a protracted shortening of the work week could occasion some consequences that might be of real danger to economic progress.

On economic plateau

The only real conclusion to draw from these facts at present is that the nation is riding along on an economic plateau while a period of readjustment is taking place. Any significant change in consumer buying, for example, might change the whole complexion of economic activity either up or down. Present indications would show that the factors in favor of an advancing economy are stronger than those that might bring on recessionary conditions.

The question of economic growth constitutes a more difficult problem for the average lay student in economic affairs. Most persons fall into the category of "lay students" as far as economics are concerned. The very nature of the term "growth" indicates a change of an advancing nature in economic activity from one period to another.

Economists have been able to prove statistically a variety of rates of economic growth for the United States by changing the period of measurement used in making the computation. For example, an annual dollar rate of growth can be measured by comparing the gross national product for an early year and a late year and then dividing by the total number of years included.

Admittedly, the choice of the beginning and ending years in this analysis will surely influence the rate of growth reported. By selecting a beginning year in the depths of the Great Depression and an ending year in the heights of the national postwar prosperity, it is possible to achieve a rather phenomenal rate of growth for the United States economy. If the selection is made as between two years of relatively similar economic circumstances, then the results will be certainly less fantastic.

Analyzing candidates' claims

What, then, is the difference between the economic growth claims of Messrs. Nixon and Kennedy when they quote widely divergent growth patterns for the national economy? How can the observer pull some economic sense from the diverse data on economic growth supplied from various sources today? The answer is that each citizen owes it to himself and the country to study divergent claims in a fair, dispassionate, and analytical vein to determine wherein the differences lie.

Essentially, the statistics are true and can be proved so. But the greatest cause of diversity as between claims will be due to differing bases upon which the statistical interpretation is founded. Once these are uncovered, it will be possible to see the true picture and to make a wise selection of one view or another to support.

Economic growth is a factor of extreme importance to all citizens for it tends to be a measure of the vitality and progress of the economic system. Thus it is tragic when, for political purposes, unfair or inaccurate interpretations of this factor are made public.

It is also unfair and unwise to compare the rate of economic growth in the United States with that of other nations where the data concerned may be meager and inaccurate. In the Soviet Russian economy, the only facts known are those which are circulated by the leaders themselves. Since it is known that at least two elements of error are present (first, only the favorable factors are distributed to the public, and second, the propaganda value of controlled statistics is recognized), then only an educated guess can be made of the Soviet growth rate. Yet this nation naively accepts the Russian statements as statistically sound as those of this nation. This is a real danger for economically uninformed Americans.

Dr. Bunting is a well-known economist and educator having special knowledge of the South.

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Washington report

By Jack James

Digest of Washington news of special interest to the electrical industry

Housing starts usually lead economic change

NEW HOUSE STARTS lead economic trends in the U. S.—as a rule—according to a study just published by the U. S. Department of Labor. The Department found that housing starts tend to contract during boom periods, and lead an upswing after general business activity has fallen off.

The reason is the mortgage market, according to the Department. During recessions there is plenty of mortgage money available, so it is easy to get money to build houses. In boom times money is scarce as business firms and industries borrow to build inventories, buy machines, and construct new buildings.

Increase in housing starts show trend

PRIVATE HOMEBUILDING rose eight per cent in August over the low level of July, according to the Census Bureau. The annual rate for August, however, was 13 per cent below that for August, 1959.

The Census Bureau predicts a moderate rise in homebuilding continuing through the rest of the year. The Bureau points to a four per cent August increase in FHA mortgage applications and an upturn in VA appraisals. The Bureau notes that discounts on FHA mortgages dropped four-tenths of a point in August. VA mortgage discounts also fell. Further mortgage easing that will spur homebuilding can be expected in the future months, the Bureau believes.

Per capita taxes lower in 1959

THIS may surprise you: per capita taxes dropped in 1959 by an average of 82 cents. This drop occurred even though total tax payments rose $1.6 billion. The reason was a population increase. Federal, state, and local governments collected $100 billion in the 1959 tax year—an average of $567.04 for every man, woman, and child. Source of these figures is the U. S. Department of Commerce.

Missile base work stoppages discussed

AT THE REDSTONE Arsenal, Huntsville, Ala., and at Cape Canaveral, Fla., electrical contractors working on America's crash program for missile development have been hindered by construction union work stoppages.

In 1958, for example, IBEW pickets shut down the Redstone Arsenal for 30 days. During the Machinists strike at Cape Canaveral this spring, all construction unions stayed off the job in a week-long secondary boycott that the National Labor Relations Board finally banned.

America's crash missile development program has crashed into some major obstacles. One of these obstacles is the union work stoppage. What's more important, while missile development and construction has recently sagged six months behind schedule, union work stoppages at missile bases have soared.

From July 1959 through June 1960 more than 78,000 man days were lost at missile bases because of construction union work stoppages. These are figures released by the Pentagon.

Last month the Pentagon called in the heads of eight AFL-CIO unions, including President Gordon Freeman of the IBEW. AFL-CIO President George Meany led the delegation. They met with Defense Secretary Gates. Gates asked these union leaders to give the construction and development of missiles and missile bases the same priority that they gave construction of camps and plants in World War II.

The country is battling just as hard for survival now as it was then, Gates told the union chiefs. During World War II the construction unions put up the greatest war facilities the world has even seen in the barest minimum of time. Gates challenged the unions to repeat the performance.

The unions agreed to cooperate.

Electrical contractors at Cape Canaveral and Huntsville will soon find out if the unions chiefs meant what they said. If they did, the contractors will benefit, but many times more important, so will the country.

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Cost of living index up 1.4 points in year

THE GOVERNMENT index by which we measure the cost-of-living stayed at a record high in August. It was 126.6 per cent of the 1947-1949 base, but the increase from August, 1959, was only 1.4 per cent.

The index hit this record peak in July. Usually the index tapers off in August because of seasonal reductions in food prices. This August, however, while the prices of fresh vegetables, fruits, and meats fell, prices for almost everything else rose, so there was a balancing out.

September construction spending shows increase

BUILDING and construction contractors—including electrical contractors—in September put in place new construction worth one

(Continued on page 131)

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The editorial and business staff of ELECTRICAL SOUTH is eager to serve you. One way in which we can help you is to make it easy for you to draw upon the wealth of technical and promotional material available from manufacturers.

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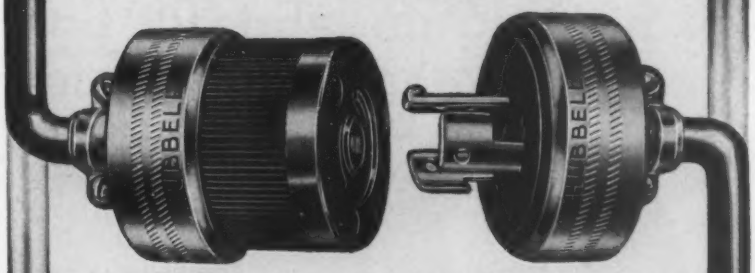

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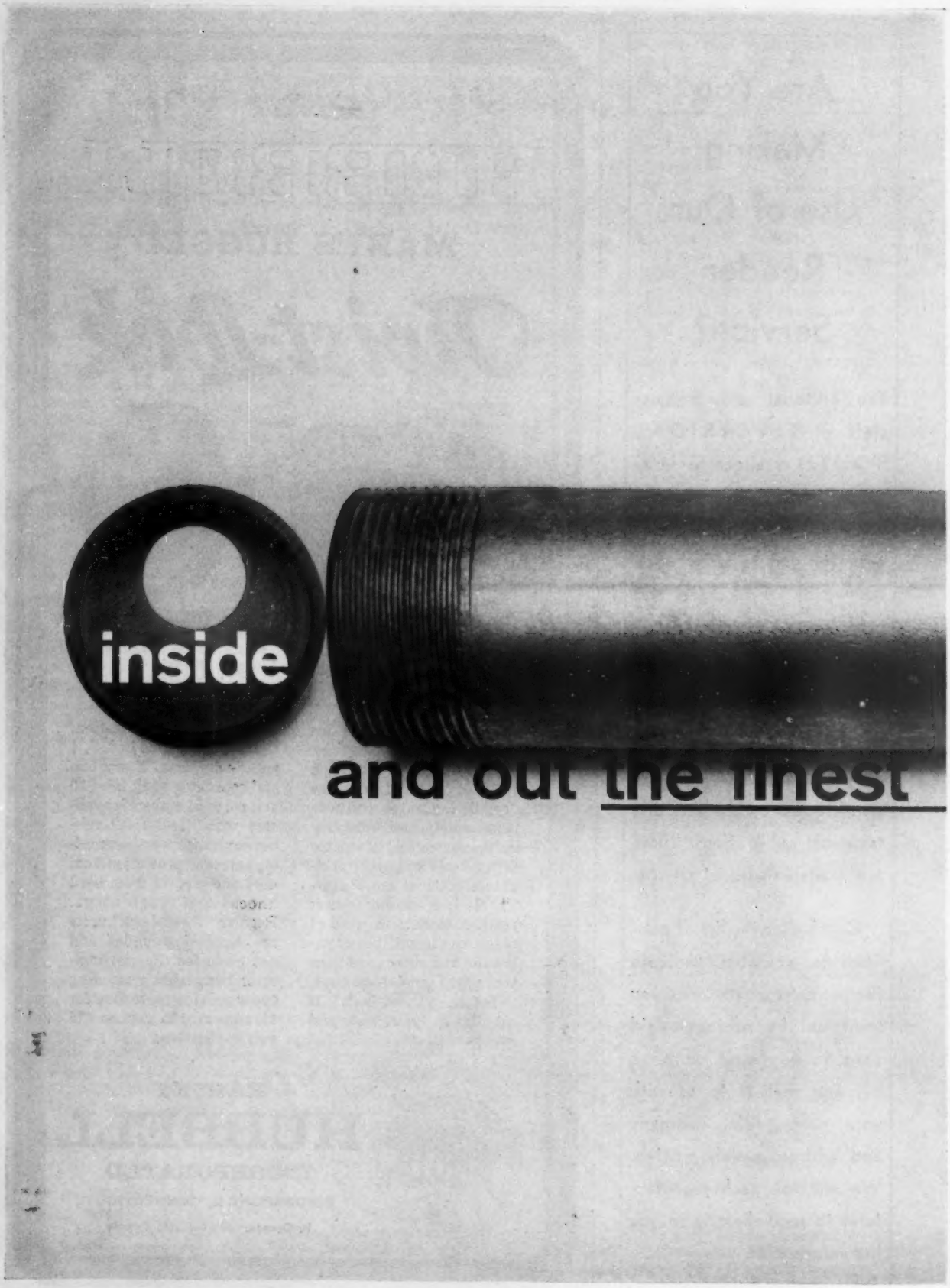
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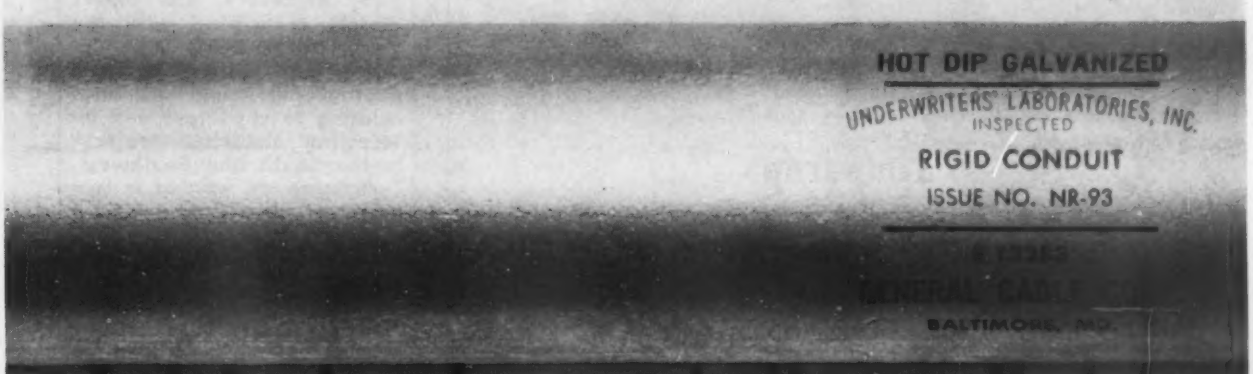

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Articles are wanted in two principal classifications:

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All articles will be given careful consideration and payment will be made promptly for all material accepted for publication.

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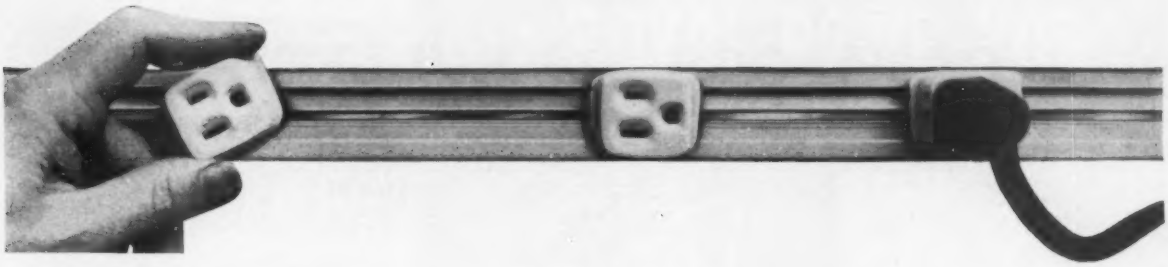

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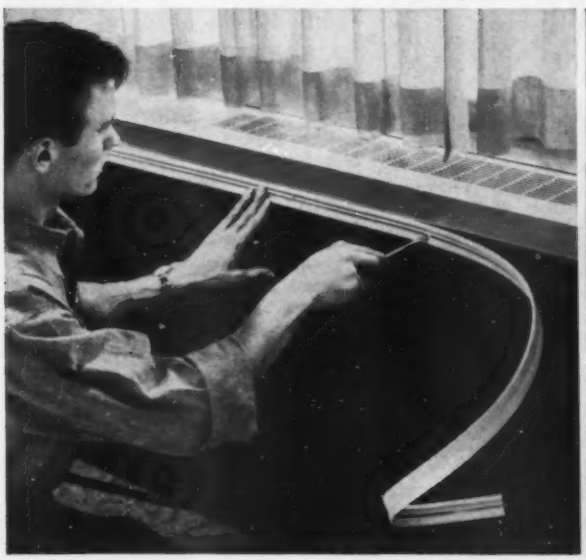

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CATALOGS and BULLETINS

Available Free to Readers of Electrical South upon Request

CABLE, WIRE, AND CORD—Catalog 71A, punched for filing in loose-leaf binder, has been made available by Carol Cable Co., Division of the Crescent Co., Inc., Pawtucket, R. I. Contained in its 24 pages is a complete listing of most of the types of wire and cable offered by the firm.
Write in No. C100 on card, pg. 17

ELECTRICAL TAPES—Eight-page Accurate Tape bulletin details data on rubber, friction and plastic tapes. Bulletin features laboratory test results, includes complete packaging information. Immediately available from Accurate Manufacturing Company, Garfield, New Jersey.
Write in No. C101 on card, pg. 17

SMALL WIRE STRAPS—Added to the one-hole Viking strap line are three new Midget straps for small wires. The #616 for fastening RX and UF 2/14, 2/12, and BX 2/14; the #416 for wires to ¼" OD; and #316 for wires of 3/16" and ¼". These galvanized straps, designed to take several sizes of wires, are featured in literature released by W. W. Cross & Co., Viking Cable and Fastening Devices, Greenville, R. I.
Write in No. C-102 on card, pg. 17

ELECTRICAL ENCLOSURES — Adjustable and non-adjustable floor boxes, watertight outlets for floor use, and conduit hangers are shown in the 20-page revised catalog #750 available from Fullman Mfg. Co., Latrobe, Pa. Adjacent to each photograph in the catalog are specifications for the product pictured.
Write in No. C103 on card, pg. 17

FUSE CUTOUTS — Extra-heavy-duty fuse cutouts of single-vent, small-bore design are described in detail as to operation, advantages, mechanical loadbreak, dielectric values, and ratings in the 8-page illustrated Catalog EHD 1258 offered by Hubbard and Co., 200 South Michigan Ave., Chicago 4, Ill.
Write in No. C104 on card, pg. 17

LINE GUN—A two-color, fold-out bulletin illustrated with step-by-step diagrams points out features and advantages of the line gun manufactured by Jet Line Products Co. Inc., 615 Fugate Ave., Charlotte, N. C. Also available are loose-leaf filler-type pages describing contents of the line gun kit and the box adapter kit.
Write in No. C105 on card, pg. 17

CONDUIT AND DUCTS—Orangeburg Mfg. Co., Inc., 375 Park Ave., New York 22, N. Y. has made available informative literature. Catalog No. 52 includes complete details concerning advantages, installation, and properties of Orangeburg fibre conduit, standard conduit—type I, and Nocrete conduit—type II. Catalog 202 offers specifications, installation data, and diagram of the complete Orangeburg Underfloor duct system. Descriptions and catalog numbers of components are also given.
Write in No. C106 on card, pg. 17

HEAVY-DUTY WIRING—Illustrations and detailed descriptions of 27 types of Circle industrial and commercial wiring products are featured in a four-page folder available from Circle Wire & Cable Corp., 5500 Maspeth Ave., Maspeth, N. Y.
Write in No. C109 on card, pg. 17

MOTOR STARTERS—Design and construction features of their automatic reduced voltage starters are described in a new bulletin released by Allis Chalmers, Milwaukee 1, Wis. Included is motor control engineered for centrifugal compressors, hammer mills, pumps, large conveyors, large fans, motor-generator sets, and other applications.
Write in No. C110 on card, pg. 17

POWER SWITCHES—A new bulletin describing its Type PV power switches, is now available from Line Material Industries, Milwaukee I, Wis. The bulletin gives complete information on switches rated at 600 or 1200 amperes and having voltage ratings from 7.5 kv to 69 kv.
Write in No. C113 on card, pg. 17

TRANSFORMER HOIST — Literature is now available from Morrison-Pelsue Co., 2001 S. Bannock St., Denver 23, Colo., describing the MoPeCo Transformer Hoist—a time saving device that permits hanging up to three transformers in thirty minutes.
Write in No. C114 on card, pg. 17

UNDERFLOOR DUCT — Formerly known as Howarduct, the Spang Standard Underfloor Duct, is introduced by the Spang-Chalfant Division of the National Supply Co., Grant Bldg., Pittsburgh, Pa., in an eight-page, illustrated bulletin featuring its simplicity in the distribution systems for electric power, telephones, and inter-coms.
Write in No. C115 on card, pg. 17

CIRCUIT BREAKER PANELBOARD—A descriptive folder featuring Quicklag lighting circuit panelboards is available through Frank Adam Co., 3650 Windsor Pl., St. Louis, Mo. This folder includes illustrations, ampere capacities, voltage ratings, and all internal construction features of these panelboards.
Write in No. C118 on card, pg. 17

ADEQUATE WIRING — "Bright Ideas for Ladies" is the title of a new booklet from American Metal Moulding Co., 146 Coit St., Irvington 11, N. J. The booklet was prepared by the Armoured Cable Section of the National Electrical Manufacturers Association to acquaint homemakers with the electrical wiring their homes need for full electrical living now and in the future.
Write in No. C119 on card, pg. 17

ELECTRICAL TAPES — Plymouth Rubber Co., Inc., Canton, Mass., is offering a new catalog on friction, rubber, and plastic tape. The full color folder gives descriptions, sizes, and packing information on their complete line of Slipknot electrical insulating tapes. Detailed specification data charts are included in the 6-page bulletin.
Write in No. C120 on card, pg. 17

SATURABLE REACTORS — This efficient method of regulating and controlling electric power for various manufacturing processes is described in a new folder available from Sorgel Electric Co., 838 West National Ave., Milwaukee 4, Wisc.

Write in No. C121 on card, pg. 17

ELECTRIC HEATING — Electromode Division of Commercial Controls Corp., 570 Culver Rd., Rochester 3, N. Y., is now offering their complete line of electric heaters and heating systems for the home. Descriptions, specifications and illustrations are included for wall and portable heaters for large and small rooms, radiant panel heaters, baseboard heaters and radiant cable heat.

Write in No. C122 on card, pg. 17

LIGHTING FIXTURES — A new catalog of recessed lighting fixtures has been released by Atlas Electric Products, 319 Ten Eyck St., Brooklyn 6, N. Y., manufacturers of Atlite lighting equipment. The 24-page, color catalog features over 100 new lighting fixtures that have been added to the Atlite line.

Write in No. C123 on card, pg. 17

DISTRIBUTION EQUIPMENT — Kuhlman Electric Co., P. O. Box 288, Birmingham, Mich., offers an eight-page catalog, CS-201, describing their line of distribution transformers of the single phase conventional type, 167 kva and below. Also available is an information sheet, CS-204, on the Kuhlman externally operated series-multiple switch for pole-type transformers 5-167 kva.

Write in No. C126 on card, pg. 17

LAMP GUIDES — Sylvania Lighting Products, 60 Boston St., Salem, Mass., offers a series of guide books containing general information, technical data, and catalog listings on their lines of fluorescent lamps, incandescent lamps, nad mercury lamps.

Write in No. C128 on card, pg. 17

FASTENING DEVICES — The Paine Co., 501 Westgate Rd., Addison, Ill., offers a new catalog on their line of hanging and fastening devices. The 31-page bulletin is indexed for easy reference, and contains information on design features, prices, and packaging.

Write in No. C129 on card, pg. 17

The *right* extension cord is essential for safe, dependable operation of on-the-job equipment and temporary lighting . . . the *right* size to carry the load, the *right* length to supply the power without voltage drop. That's why there's a Royal heavy-duty POWR-KORD to fit *every* job. Available in one quality (the very best) . . . two types (rubber and vinyl) . . . three colors (red, black, yellow) . . . four wire sizes (12, 14, 16, 18) . . . and over five handy cord lengths (10 to 100 ft.). See your wholesaler. He has the facts — and Royal POWR-KORDS in stock, ready for your work.

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WIRING EQUIPMENT—Keystone Manufacturing Co., 23328 Sherwood Road, Warren, Mich., has issued a new catalog (158 March 1, 1958) giving complete specifications and illustrations on their line of wiring installation equipment. Included in the 70-page catalog are wireways and auxiliary fittings, cutout boxes, outlet boxes, switch boxes, and cabinets, giving Code requirements, and price sheets.

Write in No. C130 on card, pg. 17

STEEL WIRE—Technical information on Alumoweld, a newly developed aluminum-covered steel wire and strand, is contained in a 12-page catalog, just issued by the Wire and Cable Division of Copperweld Steel Co., 322 Frick Building, Pittsburgh 19, Pa. Illustrated and documented with engineering data, the colorful catalog provides a complete working knowledge of this new material—its properties, advantages, applications and construction practices.

Write in No. C142 on card, pg. 17

ELECTRICAL FITTINGS — A 40-page illustrated catalog and price list on the Gedney line. Shown and listed are conduit, threaded entrances, SEC, EMT and ground fittings and box connectors for both armored and non-metallic cables. Copies are available from Gedney Electric Co., RKO Bldg., Radio City, New York 20, N.Y.

Write in No. C143 on card, pg. 17

CONSTRUCTION ANCHORS — "Anchoring for Power and Communication Lines," a completely illustrated manual on improving line construction with better anchoring, has been published by the Advertising Dept., the A. B. Chance Co., Centralia, Mo. The 25-page booklet shows how to install the right anchor at the right place in the right way.

Write in No. C144 on card, pg. 17

ELECTRICAL FITTINGS — Blackhawk Industries, Dubuque, Iowa, offers a complete catalog of electrical conduit and cable fittings. Also a special publication giving detail drawings and instructions for installing service entrance masts on low or ranch type buildings.

Write in No. C146 on card, pg. 17

WIRE PULLING LUBRICANT — Illustrated six-page folder showing the advantages of an improved Y-Er Eas wire pulling lubricant is available from Electro Compound Co., 4145 W. 150th St., Cleveland 11, Ohio.

Write in No. C147 on card, pg. 17

GENERAL CATALOG — General catalog of Royal Electric Corporation, Pawtucket, R. I., covering flexible, service and lamp cords, cord sets, extensions, trouble lights, wiring devices and fuses is available to wholesalers. Dealers catalogs may be secured from Royal distributors.

Write in No. C148 on card, pg. 17

CARBON PRODUCTS—A 28-page catalog on Motor and Generator Brushes and carbon products telling how to order brushes, grade recommendations, characteristics, and description of brush grades, is available from the Helwig Co., 2536 North 30th St., Milwaukee, Wis.

Write in No. C149 on card, pg. 17

ELECTRICAL EQUIPMENT—The Wadsworth Electric Mfg. Co., Inc., Covington, Ky., has issued a new catalog 58' Guide, containing data on their line of Safety Switches, Service Equipment, Distribution Panels, "E-Z-RED" Circuit Breakers, interchangeable and non-interchangeable, also wiring troughs.

Write in No. C151 on card, pg. 17

SELECTING FUSES — A 12-page descriptive handbook Fuseology tells how to get safest, most dependable, trouble-free electrical protection from fuses. Contains useful information on selecting right size and type of fuses —how to stop needless blows—avoiding poor contact and other troubles. Issued by Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo.

Write in No. C152 on card, pg. 17

CLAMPS AND STRAPS — Some 600 clamps and straps are listed in a new catalog put out by Victor Specialties, Inc., 775 Main St., New Rochelle, N. Y. Catalog number, size, type, and price are listed for each item in numerical order under general categories. Illustrations are also included.

Write in No. C153 on card, pg. 17

LIGHTING FIXTURES—A line of lighting fixtures specially designed to utilize the new G-E Celeste bulb, is described in a four-page catalog issued by Champion Mfg. Co., Inc., 140 West 23rd St., Hialeah, Fla., makers of the fixtures. These fixtures combine functional and decorative lighting at reasonable costs. The catalog gives specifications and illustrations of the new line.

Write in No. C154 on card, pg. 17

ATTENTION: Architects, Electrical Engineers, Contractors and Design Consultants

THERE'S NO SUCH THING AS A LIGHTING PROBLEM WHEN YOU USE STA-BRITE!

DESIGNERS
ENGINEERS
MANUFACTURERS

THE ULTIMATE IN LIGHTING FIXTURES

There must be at least one fixture available among the tremendous variety listed in our new Pricer that will meet your immediate needs! Our stock items . . . and they are usually in stock . . . range from the uncomplicated bare-tube, 8-watt channel to luminous ceilings that cover large areas. We also feature fixtures that are fabricated of aluminum to meet and beat the corrosion problem . . . not only in subtropical Florida, but everywhere.

And in addition — our design and engineering department is not averse to going to work on your more complicated special problems ...will meet even the most unusual specifications, and produce fixtures in strict accordance with architectural and engineering designs. CALL ON US SOON.

Whatever your requirements in lighting homes, offices and factories — depend on STA-BRITE'S quality fixtures and experienced engineering staff.

Write on your company letterhead for Sta-Brite's 1961 Price List.

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NOVEMBER, 196

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Available now as complete units or components . . . high quality NUTONE built-in stereo equipment that's designed to meet customer requirements . . . pre-sold to create customer demand. See them now . . . at your nearest NOLAND branch.

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Mammoth underground system

By Harry J. Miller

This article should be especially helpful to the following readers:

- Electrical Contractors
- Electric Utilities
- Electrical Wholesalers
- Electrical Inspectors
- Industrial Engineers
- Consulting Engineers

(This article describes some of the problems encountered by the electrical contractor in connection with the installation of a complete underground distribution system on Bird Key, Sarasota, Fla. Another article, describing some of the engineering features of the system, begins on page 60.)

◆ THE FABULOUS Bird Key subdivision at Sarasota, Fla., dredged up from bay bottom, reflects the natural desire of housing developers to install underground instead of unsightly above-ground electrical service as a prime means of attracting purchasers of expensive homesites.

The underground system was engineered by Philpott, Ross, and Saarinen, Inc., of Ft. Lauderdale, to meet the specifications of Florida Power and Light Company—eventual owner, according to Cliff Whitmore of Miami's Whitmore Electric, contractor for the near-$850,000 job. "The contractor needs to look to his profit defenses in such an undertaking because situations develop for which there is no previous yardstick of measurement."

Says Mr. Whitmore, "The Bird Key job differed from other underground installations we have made in a number of respects, each a potential threat profit-wise."

With lot prices ranging from $9,000 to $32,000, Arvida Realty Co., the developer, felt its lush community development well able to afford the luxury of underground utilities. In this belief, the Miami engineering organization designed the electrical installation that rings the development with a primary loop system of copper cable at 13 kv, three-phase, four-wire, and wye-grounded. This main loop comprises three single-conductor #4/0, 15-kv cables, sized to serve Bird Key from two sources. Subloops consist of three single-conductor #3 cables.

The primary comes in off poles located on the John Ringling Causeway, passes beneath a roadway, and fans out to 32 transformer vaults via a concrete-encased duct system.

The entire 600-volt secondary system is of aluminum, with each of the 511 lots and a yacht club so serviced. The lots are provided with three-phase, 120/240-volt service via delta transformer connection, in anticipation of individual electrical demands ranging from ten to 25 kw.

Aluminum cable used

Aluminum was specified at the urging of Arvida. Lighter in weight, more flexible, and lower in cost, aluminum presents some problems in connecting, terminating, and wedding to copper accessories, and requires special connectors in making the transition from an aluminum cable to the copper connector.

Reports Mr. Whitmore, "Sure, aluminum is more economical than copper conductor. But connecting it is far more difficult and requires more time and labor. We had to use special and expensive connectors. With copper, we could have made up the connections in one-third the time. And when you have to pay out three times as much for labor, you cancel out a good share of your profits.

"Fact is one of our biggest overruns in our estimate was involved in misjudging the labor required on the aluminum connectors, since we'd estimated only a little labor above the experience we have with copper.

"There is no estimating manual on this type of work and the possible variations need consideration by the electrical contractor as well as the design engineer. It's important that the contractor not be deluded by the economies claimed for aluminum cable, which is why we consider it important to keep breakdowns of costs as referral records for future bidding on such underground installations."

Besides the void in estimating data, Mr. Whitmore said, there is an obvious deficiency in the National Electrical Code which is still sketchy in its coverage of high voltage construction work, for which its guidance is considerably weaker than its more comprehensive treatment of 600-volt systems.

And so far as aluminum is concerned, this paucity of precept and example in its use explains the reluctance of some contractors to depart from copper cable because of their ingrained preferences for present connection methods and accessory features.

Speaking of the specified connectors, Mr. Whitmore said, "Once they were connected, they couldn't be disconnected economically. While a mistake with copper cable can be rectified, you've got no salvage value in cutting out a connector that has been crimped with a tool the size of a baseball bat."

"We had to run a #1 aluminum line in place of a #3 copper for the same current-carrying capacity, then this required about half again as much lead and neoprene in the covering jacket, which added up to more labor in handling and racking."

His opinion is that potheads for aluminum still fall short of full practicality, "and it does not appear that aluminum will be used for a while yet with a paper-lead combination."

He feels also that the connectors used on the Bird Key job may result in a field evaluation, indicating its performance characteristics, that will serve as a helpful guide in future installations.

Meeting labor needs

The contractor on an underground installation needs to survey the local labor market, emphasized Mr. Whitmore.

"We couldn't get enough help experienced in this line of work," he says, "which meant we had to give journeymen on-the-job train-

taxes contractor's ingenuity

ing. It took our key men to establish acceptable practices on specialized units like making up the secondary molds, because in the event of failure of the crimped connection or cable run, you couldn't turn it back out. An error or miscalculation meant cutting it and then splicing the cable!

We had our reels of cable shipped in the order in which we wanted them. That way we had exact parallel runs, with allowance for waste in making up and pulling damage. This took more planning, but it saved money."

Also Mr. Whitmore's reduction of 30 drawings to four proved to be a time-saver.

Prefabbing proves profitable

Because of the turnover in workers such as cablesplicers, Mr. Whitmore figured correctly that jigs and prefabs are natural profitmakers on a large job. Accordingly, he simplified subsequent installation routines by fabrications in the field shop.

"We had cable splicers working right from the outset of the underground installation, and it gave us a two-month jump on the job. Experienced cable splicers were about non-existent in this area. By prefabbing, we used only two cable splicers instead of five, keeping one working in the shop and one in the field. Both men began in the shop, then moved out to the job as it warranted their services."

In the field shop, the men made up all the center pothead units of the sectionalizing switches, leadins, and potheads on the oil fuse cutouts and transformers, and made up live ends as spares for all 32 transformer vaults where one live end leaves an RAL and is to go to a future cutout if needed. In that eventuality, the live end can be cut off and remade into a pothead on the entering cable to go into the cut out.

"If we had waited until we got out in the field, we would still be splicing, or we surely would have needed a larger splicing crew. We did the entire job with the two cable splicers working up to 12 hours a day.

"Normally it took ten to 14

On the right is contractor Cliff Whitmore. With him is Florida Power and Light Company's cable installation supervisor, Woody Hodges.

A bottomless steel form of ¼-inch plate, capable of withstanding pressure of 20 tons, was necessary to keep water from entering excavations designed for transformer vaults, saved considerable time.

By prefabricating components, Whitmore Electric avoided the need for a large cable-splicing crew.

Once a connector for the aluminum cable is crimped, there is no possible economical salvage method.

The fighting of quicksand was another job-delaying hazard on the Bird Key underground project.

Twenty-four hours after installation, this ductline, put in by Whitmore Electric, was flooded.

hours to do the job set-up," continued Mr. Whitmore, "because once you open the primary cable, you've got to stay with it. Here in Florida we face two big splicing dangers—high humidity and the constant threat of a sudden downpour. By prefabbing in the shop, we prevented entrance of most of the humidity encountered inside a vault or manhole."

Mr. Whitmore also points out another aspect involved in the aluminum installation: "Since the connectors were oversized, 226 handholds had to be expanded 18 inches longer than normal."

That Florida Power and Light didn't quite see eye to eye with Whitmore on the wisdom of prefabbing units is evidenced by the opinion of one official, who felt that the prefabbed leads might get damaged in handling and the high potential of 13,200 volts would burn through.

However, when test crews of the utility impressed the initial voltage on the completed system, break-throughs were negligible and traced to faults in the lead sheathing caused, perhaps, by moisture in some of the varnish cambric tape wrappings. But the prefabbing proved a major economy for the contractor.

In the installation of the ductwork, operations were hampered

(Continued on page 138)

Training course promotes electric heat

This article should be especially helpful to the following readers:

- Electrical Contractors ✓
- Electric Utilities ✓
- Electrical Wholesalers ✓
- Electrical Inspectors
- Industrial Engineers
- Consulting Engineers

◆ A COMPREHENSIVE, compact training course for electrical contractors and other installers of electric heat has been developed by Emerson Electric and is being introduced in the field now.

Approximately three hours long, the course is designed to be given in one session with intermissions. It consists of a 48-page training manual with supplements, 43 flip charts, and several demonstrations. Presentation of the course will be made by the regional Emerson Electric heat specialists.

Emerson Electric distributors will sponsor the training program in cooperation with local electrical utilities. The regional Emerson Electric heat specialist will be on hand to aid in the sessions.

"This training course is another step in our active participation in the over-all development of electric heat," says E. L. O'Neill, vice-president and general sales manager. "We have developed this course and trained our electric heat specialists in its presentation because, first, our market research has shown that contractors need and have indicated a desire to learn how to estimate, sell, and make quality installations which will guarantee customer satisfaction.

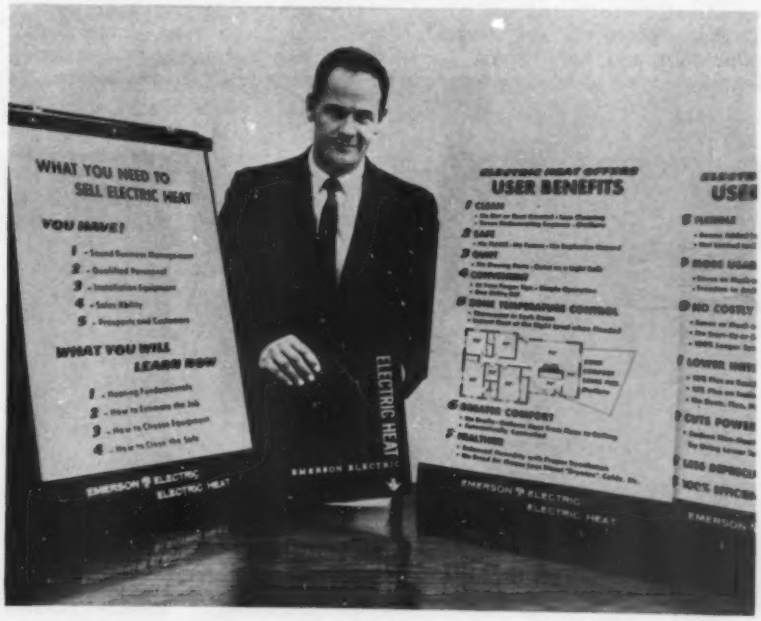
"Secondly, a complete review of many existing training programs indicated that there was a definite need for a course which covered all of the background and specific installation information required in a concise, comprehensive manner.

"Service to the industry"

"We consider this training course primarily a service to the industry," adds Mr. O'Neill. "We

(Continued on page 137)

E. L. O'Neill, vice-president and general sales manager for Emerson, shows one section of the company's new electric heat installer training program that emphasizes importance of considering all costs.



W. C. Nussbaum, assistant to the president, surrounded by some components of the program, feels completion of the course qualifies a contractor to enter successfully the electric heating field.

Underfloor cable for church heating

By Paul Jones

Electrical Supervisor
Ridge Builders, Inc.
Sebring, Fla.

This article should be especially helpful to the following readers:

- Electrical Contractors ✓
- Electric Utilities ✓
- Electrical Wholesalers ✓
- Electrical Inspectors ✓
- Industrial Engineers ✓
- Consulting Engineers ✓

◆ THE DEPENDABLE utility and economy of underfloor cable heating was discovered in what to us was an unprecedented installation problem. We thereby opened an additional market which we believe should be exploited throughout the South.

Ridge Builders has installed many cable heating jobs, but always in the ceiling. Recently, however, we have installed more than 9,000 square feet of underfloor cable heating in the new St. Agnes Episcopal Church plant at Sebring, Fla. The results have been so satisfactory that we have immediate prospects for several similar jobs and have given our area a new type of heating.

These were the job requirements: an economical, maintenance-free, rapid heating system, particularly efficient for short periods of use in the church, its parish hall or community center, and ten Sunday school classrooms in three adjoining contemporary buildings.

Problems encountered

Problems included high exposed cathedral type roofs and almost solid sidewalls of glass doors in the three buildings. The glass area and the absence of roofing insulation caused an unusually high interior heat loss. There was no space for ceiling or baseboard ducts or outlets. Furnace heating was not wanted, and a heat pump was out of the question.

The buildings were designed to take all possible advantage of Florida's warm climate and Sebring's almost constant breezes from surrounding lakes and hills. However, Florida does have short periods of cold weather when heating is essential to comfort. Since these periods are of brief duration, heating must be economical for its infrequent use.

Our solution, and a happy one, was underfloor heat cables, although we had never undertaken a similar job of this size before.

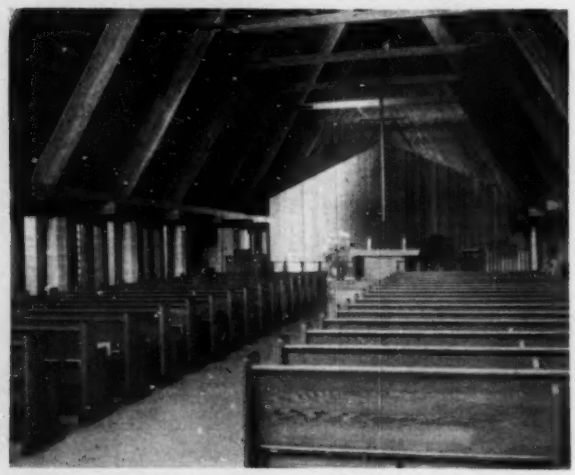
The ten Sunday school classrooms, 12 by 14 feet each, and the 32- by 72-foot parish hall, with their unbroken terrazzo floors, presented no special problems, but the church, 36 by 140 feet, was different. In spacing the cable on concrete, we had to string it so as not to interfere with six floor anchors for each of 18 double rows of pews. This required almost pinpoint accuracy since the cable lengths were only an inch and a half apart. We worked from the floor plan of the pew manufacturer, and not one of the 216 holes drilled later in the terrazzo for pew anchors touched a cable.

The 3,000-watt cable was laid in sections or bays. It was fastened to floor buttons, an inch and a half below finished floor level. We used 36 cables of about 42,000 feet with a 108-kw load from a 600-ampere single-phase 120/230 volt distribution.

Except in the 12- by 14-foot Sunday school rooms, which took one cable to a room, cable sections were 14 by 16 feet, each controlled by a thermostat. The Sunday school has ten thermostats; the parish house, 12; and the church, 14.

This gave the church plant sectionalized heating, permitting any

(Continued on page 137)

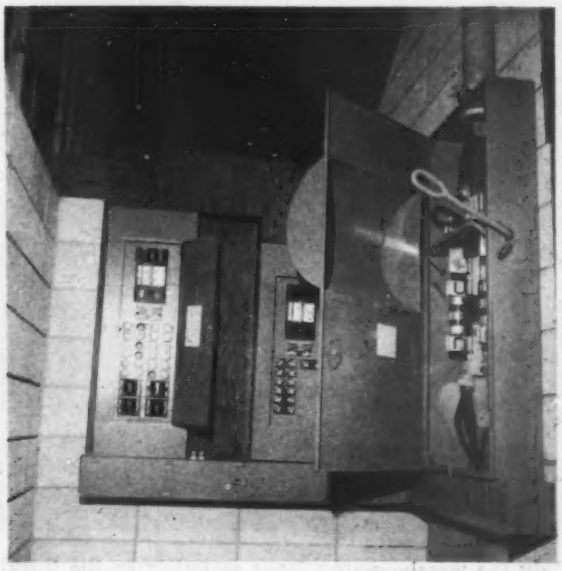


The church interior has 18 double rows of pews, and their anchors had to be avoided in laying cable.

Seven thermostats on pillars along each side of the church control the sectionalized heating system.

Underfloor heating cable, providing sectionalized heating in a new Florida church, is viewed by Paul Jones, electrical supervisor of the contracting firm which wired the group of three buildings.

The church, with its high cathedral roof and glass sides, presented a special heating problem.



The distribution panel handles all heating and lighting through a single-phase 120/230-volt system.

Organizing

By Edward H. Hitt

President
Hitt's Electrical Service, Inc.
Rockville, Md.

This article should be especially helpful to the following readers:

Electrical Contractors ✓
Electric Utilities
Electrical Wholesalers ✓
Electrical Inspectors
Industrial Engineers
Consulting Engineers

Robert Wyatt, warehouseman, collects and lists materials before their delivery to job site. A transfer order records all such action.

Only the warehouseman loads materials on the truck. Here he checks to see that materials are in accordance with the transfer order, which would also be used if materials were being sent from job to job.

◆ WE HAD BEEN growing too fast. We had developed greater volume in various fields than a one-man operation could handle. Unless we acquired the know-how of the larger operation, we felt that we would either have to curtail our growth or do what appeared preferable to us—expand apace with the demands put upon us. Yet we were not set up for the latter.

To avoid loss of time and setbacks that would come with a trial and error experiment on our own to adjust our organization, we turned to industrial management and engineering consultants. In a three-week survey, study, and analysis of our operation in its manifold details undertaken over a year ago, these experts replanned our organization with a view to continued growth and future expansion. The result has been a smoother, more productive, more efficient, and more profitable operation, able to absorb increasing volume.

The delegation of authority, job definition with each job carrying specific duties, the introduction of a daily job cost system during job process letting us know the actual financial picture of a job from day to day and maintaining a certain percentage of profit, a new time card system for the mechanics for payroll and labor costs charged to a job, as well as a new purchase order system for more efficient handling and flow of materials were among the new and beneficial procedures that emerged from the study. I shall describe here a few of the aspects that may

for contracting profits

be of greater interest to readers.

Cost records on every job are now set up for materials and labor. Cost information on materials by item includes the date as it appears on invoice, name of supplier, number of invoice, labor hours as compiled from the weekly time cards and broken down according to regular time hours, regular time amount, overtime and amount, cost of materials as charged from invoice substantiated by receiving slips, costs of tools and supplies, miscellaneous (any item not classified into other categories), and totals.

Cumulative totals are maintained and are compared with the estimate in terms of progress and percentage of completion. These records are maintained by the office manager, who at the start of the job was given estimated cost figures by the engineer broken down in the same manner as cost classifications in the cost summaries. Cost figures are separated from estimate figures by a horizontal line in red ink. Weekly totals are transferred to the job cost summary.

A contract control sheet by job includes the date, reference number (statements sent and checks received by number are entered here), total amount billed, retainage (amount withheld from payment requisition), date payment is received, and balance. Retainage is treated as an amount due, not as an account payable. There are three possible balances, depending upon how this account is treated. If the amount paid is less than the requisition, then the difference should be treated as an amount due for work completed.

The contract control sheet is a point where all contractual information is recorded to expedite job control. No specific form is needed, since habit and requirements standardize the layout of the sheet.

Charges recorded daily

Charges are made daily on the job cost summary sheet as they occur. At the end of the week the totals from the columns on the item summary sheets are transferred to the respective columns on the job cost summary sheets. After all weekly transfers of totals are made, a grand total is made on the job cost summary sheet. These totals are submitted to management in a report.

A weekly time card used for payroll and labor cost distribution was designed by the engineering consultants, and includes employee's name, clock number, date the workweek ends, job number, item code, days of the week, and total hours. The job foreman distributes time cards to each mechanic on the job, and enters hours and item of work to which the mechanic was assigned as well as the actual hours he spent doing it. After the job foreman checks his extensions, the time card is computed by the office for payroll and labor cost distribution.

We have increased efficiency in the ordering and delivery of materials, saving man-hours and thus making jobs more profitable. Two forms are used, a transfer order to control materials internally, and a second form, a work order, for receiving calls for service work, scheduling that work, and assigning the proper mechanic. The two part transfer order is used when materials are withdrawn from the warehouse for jobs, or when materials are sent from one job to another, or back to the warehouse. Thus it serves as a record of the movement of materials. After delivery has been signed for, the transfer order is priced upon return to the warehouse, and is then turned over to the office.

All calls for service are written up on the work order by the warehouseman, scheduled by the general superintendent, and all supplies and materials prepared for the serviceman by the warehouseman.

Four-part work order

The four-part work order is used to gather and distribute material costs to the respective jobs and items of work within these jobs. The more current or up to date costs can be kept, the more useful they are. Time is an important factor in determining the most effective method to be followed in recording these costs. The ideal situation from the standpoint of accuracy is to charge materials to jobs from the suppliers' invoices, but this necessitates prompt receipt of the invoices from the suppliers after materials have been delivered.

In order to effect internal ma-

(Continued on page 136)

Job foreman, Edward Kolacz, makes out a requisition for materials needed on an office building.

This electrician works from a four-part work order listing his job order, materials and costs.

A weekly time card for each worker lists assigned hours, actual hours worked, and materials used.

Decentralized

By Ross L. Holman

This article should be especially helpful to the following readers:

Electrical Contractors ✓
Electric Utilities
Electrical Wholesalers ✓
Electrical Inspectors
Industrial Engineers
Consulting Engineers

Billy Hitt, seated, and Bernice Huffine check the accounts on some of the company's finished contracts. A system of personal initiative among their workmen has paid off in growing profits, and is developing responsible lead men capable of handling more business.

One of the Hitt trucks is being loaded at one of the warehouse doors. The truck body, designed by the two partners for their specific uses, features an interior equipped with shelves and compartments.

◆ STARTING OUT with what he called a "shirttail" enterprise in his own backyard, Billy Hitt now has 15 electrical crews, each working independently. Each crew is entirely on its own except for being a segment of the B. Hitt Electric Co., of Goodlettesville, Tenn., to which it reports and turns in its work orders.

To the lead man of each crew is delegated all the responsibility for the handling of each job in his own way with practically no central direction from the head office about methods, practices, or how to work out any detail. He is on his own as though he were working entirely for himself, and all that the Hitt Electric Company requires of him is that he show results, treat his customers fairly, and make his jobs pay off.

"This method of management saves a lot of problems," says Bernice Huffine, partner of Billy Hitt. "Besides getting an hourly pay rate, each lead man works on a profit-sharing basis and it is to his financial interest to make each job return a profit.

No close supervision

"You don't have to stay continually on his heels to see that he doesn't waste time or company supplies. He would have to share with the company in whatever waste or loss for which his crew is guilty."

It might be well to state that the B. Hitt Company specializes almost entirely in residential wiring of new homes under construction. It wires each year about 2,500 new residences that are built in Davidson County, which includes Nashville. It also wires

organization aids electrical contractor

homes in adjoining counties. The company doesn't solicit any commercial wiring and does only such commercial jobs as are requested by its residential customers. Hitt, however, has enough of these fringe jobs to keep one of its 15 crews busy.

"We try to stay off commercial jobs," says Mr. Huffine, "because we feel that the more we specialize in residential wiring, the more efficiently it will be handled by the crew that does it. Each crew has handled so many residences that it can complete each home with so little loss of time and waste that our company can do it at less cost than most competing contractors and thus receive a better break in bidding on it. Since each crew shares in the profits, we frequently find that the lead men are a help to us in landing new contracts."

Dual responsibility

Back in 1946 Billy Hitt set himself up as a pint-size electrical contractor in the backyard of his home. He was lead man of his one crew, and Bernice Huffine, now a full partner, was a helper. They used a Model A Ford truck. With one other helper they began wiring such homes as they could secure from general building contractors. When new contracts came in faster than this crew could handle them, Mr. Huffine took charge of a second crew with one or two newly hired helpers.

By this time Mr. Huffine was well enough trained to accept full responsibility for the contracts he handled. When business increased to where more crews were needed, both men saw the advantage of using well trained lead men who could assume full responsibility for each job. They would be relieved of the burdensome supervision of chasing after each crew and trying to make all the more important decisions for it.

"In order to get the kind of men who can assume this responsibility," says Huffine, "we train our own personnel from scratch. We hire each new employee as a helper, and we usually take him on as a boy in his early twenties. We prefer youngsters without any previous experience in electrical wiring so we can train them completely in our own methods. If we employed men who had already had years of experience, they would have to unlearn too many of their old techniques to adapt themselves to our needs.

"Each newly hired boy starts in as a helper under a lead man who himself began as a helper in the same way. He can look forward to being the lead man of his own crew when an opening occurs, provided he has acquired the essential skills. Generally speaking, each of our 15 crews is composed of the lead man and one or two helpers. I would say that our workers, as a whole, average between 25 and 30 years of age."

The Hitt company doesn't solicit the wiring of old residences and does such jobs only when it can see no way to avoid them. Wiring an old house, of course, is a more complicated task than doing work on a new one under construction. By confining its program to new construction, the company can keep its specialization activity down to a level consistent with the best efficiency.

"Having built up enough business to use 15 crews, we can buy our supplies on a volume basis, and thus cut our costs still more," says Mr. Huffine.

Supplies stocked ahead

The company now has a large warehouse which is kept stocked ahead with all the needed supplies and tools for its residential contracts so that no delay occurs when a new job turns up. A stock man stays on hand to keep the supplies classified and to issue them out on each contract.

The warehouse is located across the street from the backyard where the business started. The loading area is enclosed by the warehouse on three sides and a fence on the fourth. Several loading spots permit rapid obtaining of materials from the warehouse.

After starting the original Hitt business with a Model A pickup truck, the two partners began designing the type of truck body that would enable them to most efficiently handle their work needs. They now have each crew's truck equipped with an enclosed body made to their own specifications. It has all the essential inside fixtures and compartments and is a complete workshop vehicle. It carries everything needed for each job, and it is rare that any special trip has to be made for anything to complete a job.

Over 90 per cent of Hitt's residential wiring includes the installation of electric heat. In this area very few new home builders ever consider the use of any other form of winter comfort. Hitt's specialization on residential wiring has enabled the company, through its longtime experience with many jobs, to cut the cost of wiring down to the extent that it can usually add electric heat to one of its regular wiring installations at a cost of no more than $200. That includes either the radiant type or the wall heater type.

One of Hitt's 15 crews handles all the radiant heat installations and does nothing else. This requires a special kind of skill and, in order to speed up such jobs, the company feels that it needs a crew that can do enough of them to cut the expenditure of time to the lowest possible minimum. The rest of the 15 crews, with the exception of the one doing commercial work, do residential wiring altogether.

With its system of decentralization the company assigns each of its crews to a separate area of the county. "When an order comes in for a wiring job in a certain area," explains Mr. Huffine, "we hand the job over to the crew that has been assigned to that area. Each crew is responsible for all follow-up work for its area, handling complaints, expansions of installations, etc. The lead man can frequently see prospects for new business in his territory and follow them up for the benefit of himself and the company."

The company now employs between 30 and 40 people, including share-profit workers. It does an annual gross business of over $1,000,000.

All-electric concept applied to

By W. U. McCoy

This article should be especially helpful to the following readers:

Electrical Contractors ✓
Electric Utilities ✓
Electrical Wholesalers ✓
Electrical Inspectors
Industrial Engineers
Consulting Engineers ✓

◆ OKLAHOMA CITY electrical contractors have completed work on two large totally-electric apartment houses, the first in this area, and interested observers are coming from Memphis, Dallas, and other major cities.

Complete flexibility of individual heat pump units, with each tenant getting exactly the operation he wishes, separate metering which gives the option of landlord or tenant bill payment, cleanliness, convenience — these have been important advantages for multiple dwelling builders.

Since both projects have spacious units with every convenience, are built around courtyards with swimming pools and cabanas, and have luxury appointments, they are filling fast. After this strong public response, other such projects are on the drawing boards.

C. W. Boggs Electric Company had the contract for the Meridian Terrace Apartments, 2321 N. Meridian; and Wetherbee Electric Company had the contract for La Villa Apartments, 62nd and N. Villa.

Two approaches

Differing approaches were used for the two installations.

C. Don Snyder, Wetherbee president, said "It was our first all-electric apartment house. La Villa has 30 heat pumps for forced hot or cool air to each of the 1500- to 1700-square foot area apartments. Each apartment has two baths, with electric ceiling-type heater; 40-gallon quick-recovery hot water heater, built-in cook top and oven, dishwasher, disposal, and miscellaneous appliances."

At La Villa, two heat pumps were located together outside on a slab at ground level of the lower apartments of the two-story building. For first floor units, ducts were run under the floor for perimeter heating. A split unit was used for the second floor, with the air distribution system in the attic and pipes running between the two units.

"All units are equipped with auxiliary resistance heating," Snyder said. "Strip heaters are used in ducts, adjacent to heat pumps on the first floor, and adjacent to fan coil units on the second floor."

Very careful engineering is necessary for such an apartment project, it was pointed out by Ray Dolan, secretary-treasurer of Tom Dolan Heating Company, suppliers for La Villa. "It can't be done by guess," Dolan said. "Selection and sizing of equipment must be engineered. Right now we're doing engineering that actually should be done by a consulting engineer. We're trying to sell more of them on the idea of doing it, but we had to get some installations in first." La Villa was completed about June 1.

The Meridian Terrace project, also a two-story arrangement, has 36 two-bedroom units and four four-bedroom units and four apartments per floor in unit buildings. The entire project is linked by a common roof.

C. W. Boggs, of Boggs Electric Co., said installations are entirely in the attic at Meridian for both upper and lower apartments, with ducts running down to apartments from respective units.

Mr. Boggs said it was felt that savings were made by the attic installation, although an attic fan is used to clear out attic heat. Boggs' men made the first trip on the project January 15, finished all apartment wiring in May, then did underwater lights for the swimming pool and installed weatherproof plugs in the yard for portable lights. A photoelectric eye was used for all outside lighting, with the eye on the house meter.

"Although this was our first heat pump apartment project, most of our work is in residential wiring and we're getting into heat pump jobs more and more," Boggs said. "Most such jobs are in the $100,000-type home, but some are now going in the $30,000 to $40,000 range."

Boggs expects heat pump jobs to go in still lower priced homes as equipment and methods are developed further. He is now figuring with contractors on other such apartment projects.

"The two apartment projects are real 'Cadillac' jobs," mechanically, emphasized Bill Scheidt, power sales engineer for Oklahoma Gas & Electric. "Yet they are less expensive to install than the very worst hot-chill water system."

Scheidt estimated such a project to cost about half a four-pipe hot-chill water system, although not less than a two-pipe job.

Rates become attractive

Electric bill rates have become a positive selling point.

Scheidt says Meridian Terrace bills will average around $15 to $17 a month, and La Villa about $20. This includes kitchen, hot water, dishwasher, disposal, heating and air conditioning, lighting, television, and all miscellaneous appliances.

This is made possible by the new OG&E rate RT-1 residential, inaugurated recently, although apartments were sold under the old rate. Difference in the old and new rate runs about $8 a month on a small apartment.

To qualify for this rate, everything must be done electrically. It is based on first 300 kwhr or less, $6.50; next 400 kwhr, 1 cent per kwhr, to a total of 700 kwhr per month. In winter, all kilowatthours in excess of 700 are 1 cent. In summer, all in excess of 700 are 1.9 cents per kwhr. Plotted curves on this new rate will stay below most other utilities in the region, Scheidt believes.

At Meridian Terrace, the original estimate had been 600 kilowatthours base per unit, but early experience shows it to be around 558 kilowatthours base load per month. Scheidt points out the new apartments use about three times as many kw hours as a more conventional apartment.

"It is the only way we know of really getting flexibility in multi-

apartments

ple dwelling projects," Scheidt said. "Each individual tenant gets exactly the kind of operation he wants in his individual apartment. It's difficult for some people to believe what they see about this system."

Scheidt also points out to prospects the cleanliness of the heat pump system, and the fact that tenants can grow plants to germinate any time during the year.

The OG&E power sales engineer says it will probably be 15 degrees or below before the booster element is needed, and then it will not actually be on long.

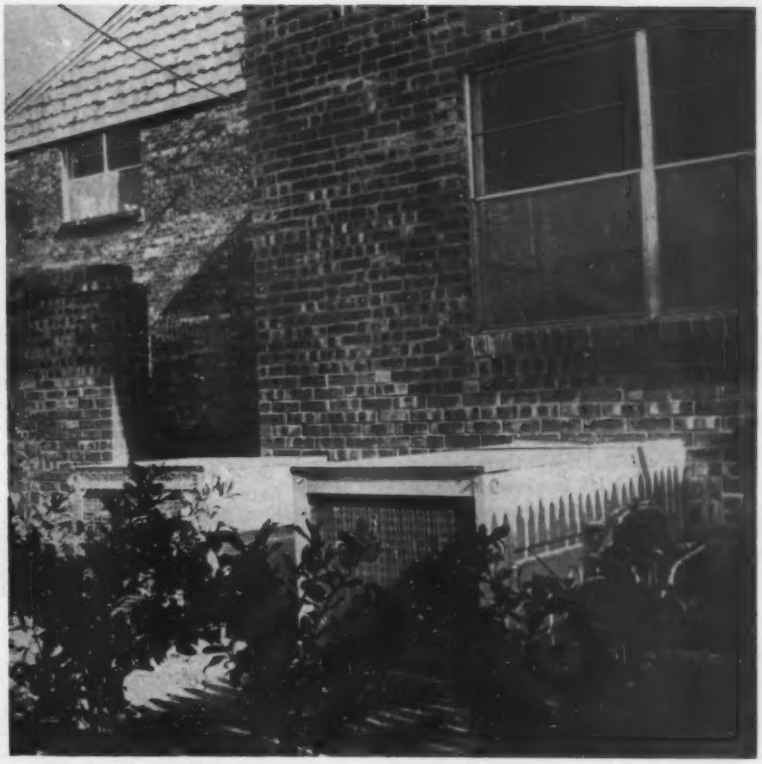
He explains to prospects that in the winter the outdoor section becomes cold, and that when the temperature of the coil gets below 32 degrees as it extracts heat from the air, water from the air freezes on the coil. "When that coil comes to a point where it is more efficient to take off the frost than to let it remain, we take it off, through a sensing element. That element notifies the section of the machine to set in motion a control sequence that allows the unit to run in its air conditioning cycle two to three minutes. Then the outdoor coil becomes the hot coil and the ice melts. During this, the outdoor fan shuts down, and an indoor fan comes on and the strip heater comes on to temper the air.

"It will also act as a booster if the machine for any reason can't carry the load. Say the thermostat is set for 74. If the machine won't carry the load, the booster comes on for a short period, then goes off. Some machines are set on a one degree difference, some one and one half degrees."

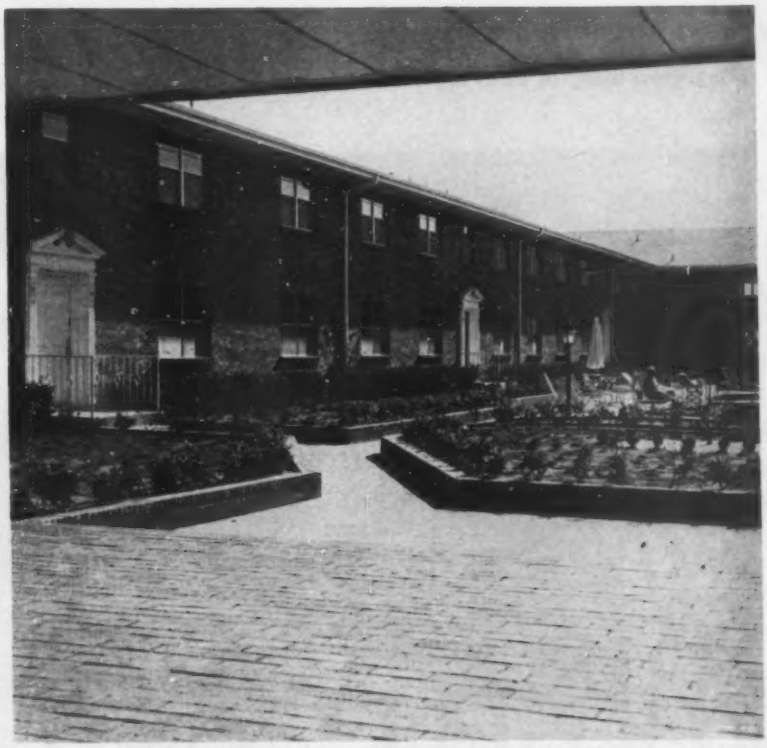
Scheidt brought up a point he said some people have difficulty understanding. "Below 25 degrees the heat pump runs all the time on the heating cycle, yet uses about half the kilowatthours it would if it were on cooling system at 105 degrees."

At Meridian Terrace, Scheidt said, at 25 degrees the pump will run 24 hours a day for 25 or 30 cents a day; at La Villa, if the unit runs all the time, it costs 55 or 60 cents. High bill at Meridian is estimated to be between $21 and

(Continued on page 137)



Pairs of heat pump installations are grouped outside at ground level at La Villa, above, and are placed in the attic at Meridian Terrace.



Totally electric La Villa includes an outdoor swimming pool and other luxury touches. Monthly electric bills will be about $20.

An "out" for small contractors

By Frank C. Stetka

Customcraft, Inc.
Bethesda, Md.

This article should be especially helpful to the following readers:

- Electrical Contractors ✓
- Electric Utilities ✓
- Electrical Wholesalers ✓
- Electrical Inspectors
- Industrial Engineers
- Consulting Engineers

◆ THERE ARE many small contractors today putting up a fierce struggle in the highly competitive field of electrical contracting. Competition is squeezing the one-man operation. The load has become too complex to handle efficiently.

There is a lack of time to keep records that tell him from day to day where he stands on a job. Without them he cannot make realistic estimates that mean profitable jobs. Too many small contractors work 16 and 18 hours a day. How many of them are doing more than eke out an uncertain living?

I know that a great many of them could earn $150 and even $200 a week, in the employ of a sound going concern, "swinging tools." They would be free of the multiple responsibilities of the one-man operation of estimating, paperwork, collections, payrolls, long hours, and uncertain earnings. I once felt the way they do about being in business for myself and heading a growing and flourishing operation. Today it takes more than a master electrician's license to come out ahead.

Experience shows

The electrician who acknowledges to himself that he might be better off "swinging tools" in the employ of another may be taking the better of two courses. About a year and a half ago I became electrical superintendent for a home improvement builder whose departments, set up for electrical work, carpentry, painting, and plumbing were essential to giving prompter service to customers.

While 30 to 40 per cent of our volume of electrical work is done for the builder, we handle approximately 60 per cent independent of the home improvement operation. In the year and a half of my association with the builder, I believe some 500 permits have gone through my hands. We average six to eight heavy-ups a week.

The advantages to a builder or home improvement dealer of having his own departments of mechanics are many; increased job turnover is possible since there is a better control of electrical work and inspection. My department coordinates electrical work with the construction of large recreation rooms. Formerly, a wait of two weeks for electricians to get on a job retarded turnover; today the electrical department gets on a job, promptly giving the builder priority over independent jobs. Prompter service and greater efficiency mean accelerated turnover.

The electrical department is staffed by nine electricians and one electrical superintendent.

(Continued on page 136)

Frank C. Stetka, electrical superintendent of Customcraft, Inc., discusses the proper location for kitchen lights with a company electrician.

Installing residential heavy-ups is part of a responsible job that need not include the headaches of competition as a private contractor.

50% MORE LIGHT

FROM ANY 2-YEAR OLD 40-WATT SYSTEM

New G-E Premium 3 Fluorescents. If your customer's present 40-watt fluorescents are two years old or more, he can probably boost his lighting level by 30% to 50%—overnight—without spending a single capital expense dollar! How? By replacing the old fluorescents with new General Electric Premium 3 Lamps. Fact is, he'd gain *at least* as much extra light as his present lamps would deliver if they were a foot longer and used a lot more electricity.

G-E Premium 3 Lamps are new from end to end. New "Wattage Miser" Cathodes that cut wattage loss . . . new, more efficient "Bonus" phosphors . . . improved gas mixture. And like the *standard* 40-watt fluorescents, the F-40, they operate in starter-type *or* Rapid Start circuits. General Electric Premium 3 Lamps are first to deliver over 3,000 lumens . . . giving you more light at the lowest possible cost. For more information, call your G-E Lamp distributor today—or write: General Electric Co., Large Lamp Department C-032, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Electric feeding and storage plan reduces farming costs and labor

By W. U. McCoy

This article should be especially helpful to the following readers:

- Electrical Contractors ✓
- Electric Utilities ✓
- Electrical Wholesalers ✓
- Electrical Inspectors ✓
- Industrial Engineers
- Consulting Engineers

◆ AN OKLAHOMA FARMER has completed installation of an electrically operated grain storage, mixing, and feeding operation that is setting the pace for grain and cattle enterprises in this area. Farm leaders who have examined the set-up expect this smooth and rapid one-man system to spur the demand for electrical installations on farms throughout the state.

George Briscoe, who operates a 2,000-acre grain and cattle combination near Edmond, Okla., now needs only to take a few steps to press buttons for the electric motors, or move a lever to the appropriate number of a bin, to mix, store, grind, or send a balanced ration of feed out to his 300 head of Angus cattle. Augers distribute the feed evenly in self-feeders.

With gear reduction from an auto transmission, a one-hp motor operates a 300-bushel-an-hour elevator. The elevator can move mixed feed or grain, by lever-selected spout transfers, in any one of six storage bins, to mixer, or to truck-height spouts over the driveway.

By making maximum use of gravity flow, the elevator can fill or drain any one of the bins.

Savings, Mr. Briscoe estimates, are $8 a ton on feed mixes alone, not counting saved transportation and labor.

A concrete driveway over a central pit is located between storage bins. Grain is dumped over grills into the pit. The bottom of this pit is slanted so grain is picked up by a bucket conveyor. Buckets lift grain to overhead distribution spouts, numbered to correspond with storage bins. Grain then drops into the selected bin.

Feed in this bin is being distributed electrically by an auger.

Any slant-floored bin may be opened by lever-selection to flow into the slant-floored central pit, where it is moved by elevator to the mixer, when needed for feeding.

The one-ton capacity mixer is operated by a five-hp motor, and the feed may be sent from the mixer to bins, trucks, or grinder.

A "freight" elevator is operated by a three-hp motor and carries bags of nutrients, proteins, etc., 18 feet up to the mixer. This device has a floor of plywood set in a metal frame, and runs up on garage door-type tracks.

After feed is ground it is sent by gravity out to the self-feeder, where a one-quarter horsepower

(Continued on page 134)

The electric feeding and storage system includes a plan of numbered spouts and bins. Grain is routed by selecting numbers with a central lever.

Farm owner George Briscoe ascends the "freight" elevator to the mixer. A three-horsepower motor, shown at upper right, provides the lift.

Contractors tell how

Preparation needed to realize benefits of aluminum conduit

By Frank Tuttle

Work Superintendent
Fred H. Spaulding
Electrical Contractor
Oklahoma City, Okla.

◆ SAVINGS and advantages are possible in the use of aluminum conduit, but unless adequate preparation is made and suitable equipment and tools are at hand, trouble on the job will follow.

Labor saving is quickly apparent. There is some such saving on smaller sizes. But two-inch pipe and larger sizes, which ordinarily take two men to handle, can be handled by one man, if they are aluminum.

We first began a major use of aluminum conduit during the steel strike last year, and have since handled some large jobs with aluminum.

An example is the Franklin Roosevelt Junior High School in Oklahoma City which we have just completed wiring. We had 35,000 feet of ¾-inch and 1,620 feet of 1-inch aluminum conduit.

You run into real trouble trying to use steel tape in these small sizes of aluminum conduit. Regular steel tape tends to dig into aluminum. The answer was use of a pressure cylinder to blow a line through conduit. We shot line through 100-foot conduits in such areas as the gymnasium.

On larger sizes of conduit, all of our pulling equipment was rigged with poly rope, because steel would cut in on a hard pull. We did use an 18-inch flexible end on steel tape to advantage in some places.

We have found a precaution is in order on threading. When using a die to cut thread on aluminum conduit, it pays to keep it for that purpose alone. If you use a die to cut steel pipe, then when you cut aluminum it doesn't give you the quality of thread you need.

And, along the same line, we learned quickly that it was necessary to coat joints on which pipe is screwed, otherwise the joint will freeze and you can't unscrew it. We first bought a commercial preparation, costing $10 a gallon, but the best preparation we have found is a mixture of graphite and cup grease. It is effective, and not expensive. We use a mixture of ¼ pound of graphite to one pound of cup grease.

One disadvantage

One disadvantage we have found is that you have to coat all pipe that goes in the floor, whereas you wouldn't with steel. For this we devised a long open-topped tank, placed a man on each end with rubber gloves, dipped pipe, and set it in a rack. We used a standard, government-approved coating.

On all our big pipe we used steel els where we had a bend, but on the ¾-inch and 1-inch it wouldn't pay to cut a steel el. And on bending, we have found you can give aluminum rougher treatment.

Our work has gone smoothly, and with less manpower overall, especially when using the larger aluminum sizes—after we set up the necessary tools and procedures. But it is necessary to make special preparation for aluminum conduit work.

Office-to-truck radio system cuts service truck mileage

By Ruel McDaniel

◆ BUNYARD ELECTRIC CO., San Angelo, Texas, utilizes two-way radio communications between service vehicles and the office to cut service truck mileage and save time on routine as well as contract jobs, according to Doc Willeke, co-owner.

Mr. Willeke estimates that the system has cut at least 35 per cent from the mileage of service trucks handling small repairs. He believes that time on some smaller construction jobs has been cut as much as 10 per cent through use of the two-way radio set-up.

"Service men have standing orders to call back to the office when they complete a routine service call," Mr. Willeke explains. "When a man calls, the bookkeeper checks other service calls and sends him on the one nearest to his location at the time. This saves his coming back to the office or taking the time to go to a telephone and call in."

The communications system is equally as valuable on contract jobs, according to Mr. Willeke. For example, an electrician may discover that he needs something from the shop or from the warehouse for use on the job at once. To stop work and drive to the shop to pick up the necessary materials or equipment would require a great deal of time, particularly since the company's plant is located three miles beyond the city limits.

So he telephones to the office, explains what he needs and asks that it be rushed to him if there is another truck or a pickup and a driver available. If so, he generally can continue working until the needed materials arrive.

But even if he must stop work and drive to the shop and pick up the materials himself, he still

Dispatcher Mrs. Grace Murray radios repair order to electrician.

saves some time, because a stock man will have prepared the materials or tools for instant loading as soon as the truck arrives, thus eliminating the time required for the electrician to assemble the needed equipment.

Name plate attracts new electric business

By Earl G. Bennison
Bennison Electric Co.
Annandale, Va.

◆ WE FIND it good promotion to post our name plate outside a building where we are carrying out a job. The adjacent business and residential community is always interested in new construction or remodeling going on around them.

Curious about modern innovations in lighting or power, passers-by stop to take a look and inevitably want to learn who is handling these changes and what is actually taking place, and we regard this as a fine opportunity to make ourselves known.

Our name plate tells them who we are, the nature of our business, and where we can be located. When the job reveals new and interesting approaches to electrical services, we gain prestige for having been assigned the job.

We use a uniform design in our signs on buildings, on our truck panels, stationery and instructional tags to customers, and on our business cards. Using clear prominent black printing on a yellow ground, the sign includes the national slogan "Live Better Electrically." The repetition of the name design impresses itself on people, and they learn to associate our name with Housepower. Several jobs have come from this.

A sign posted over every job Bennison Electric handles has proved to be good promotion.

Power equipment accounts for 20 per cent cost saving

By John S. Edmands
President
Bethesda Armature Co., Inc.
Bethesda, Md.

◆ WE LOOK UPON power tools and equipment as bringing 20 per cent in labor savings. Alert for new power tools of service to the electrical contractor, we consider them vital in carrying out jobs efficiently and competitively. They figure importantly in our computation of job costs.

In our power tool and equipment investment of $4,000 are to be found jetline guns, stocks and dies to four inches, electric cable pullers, power vises, electric drills of all sizes, and stud fasteners. Card systems are maintained on each tool with one card per tool giving name of tool, manufacturer, date of purchase, cost of purchase.

Activity of tools is recorded on the job sheets by date of use, withdrawal date or date it was borrowed for another job, and its return date. Tools are charged to a job in accordance with amount of service derived from them. Job foreman are responsible for power tools and their movement back and forth on jobs. In our records amortization on tools is computed as on trucks.

Every tool is checked when leaving for a job and checked again when it is returned. Cleaned, oiled, and repaired in our own shop, power tools have a record of maintenance placed on their cards.

I personally train all mechanics in the use of power tools on a job, incorporating at the time safe handling. It is a rare occasion when a tool is found not as serviceable as we had thought, and represents loss. If we can sell the tool and so dispose of it, we do so.

In our commercial work we have found certain tools of exceptional time and labor-saving value. Take the compression gun, for example, for placing lines through any size conduit. Time-savings as against manual han-

(Continued on page 134)

A dragline is being shot with a jetline into a ¾-inch conduit.

A Bethesda Armature employee is making a short test on a jig saw.

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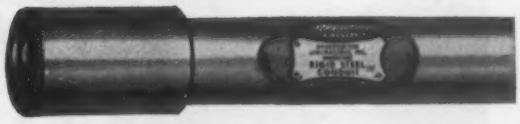

GALVITE® RIGID STEEL CONDUIT (Blue Label) is a heavywall, hot-dipped galvanized conduit with a special coat of baked-on lacquer inside and out for greater corrosion-resistance and long life. **ENAMELITE®** Rigid Steel Conduit (Red Label) heavywall conduit is protected inside and out with a baked-on coating of tough, wear-resistant enamel for greater protection against moderate corrosive action.

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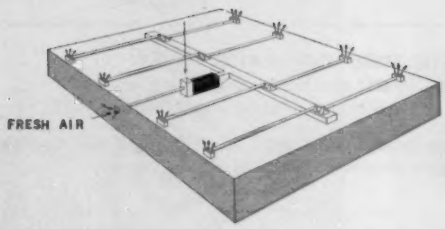

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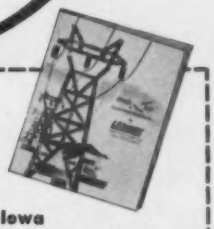

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New Revere 2500 Series Urbanoval luminaires use 100, 175 or 250-watt mercury lamps. Unitized Urbanoval features built-in constant-wattage or reactor ballasts. Conventional Urbanoval is designed for external ballasting. Both types are available with or without mounting adapter for E.E.I.-NEMA standard plug-in locking-type photo-electric control. Choice of Revere-Corning Pyrex® molded prismatic refractors provides I.E.S. Type I or Type II—4-way distribution (or Type III or 4-way with phosphor-coated lamps). Available with 1¼" or 2" slipfitter.

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New Revere 2600 Series Endoval luminaires use 250 or 400-watt mercury lamps. Unitized Endoval features built-in constant-wattage or reactor ballasts. Conventional Endoval employs same housing, reflector and Revere Corning Pyrex® molded prismatic refractor, but without built-in ballast components. Both types are available with or without mounting adapter for E.E.I. NEMA standard plug in locking type photo-electric control. Adjustable socket positions produce A.S.A. I.E.S. Types II, III, or IV with proper choice of lamp.

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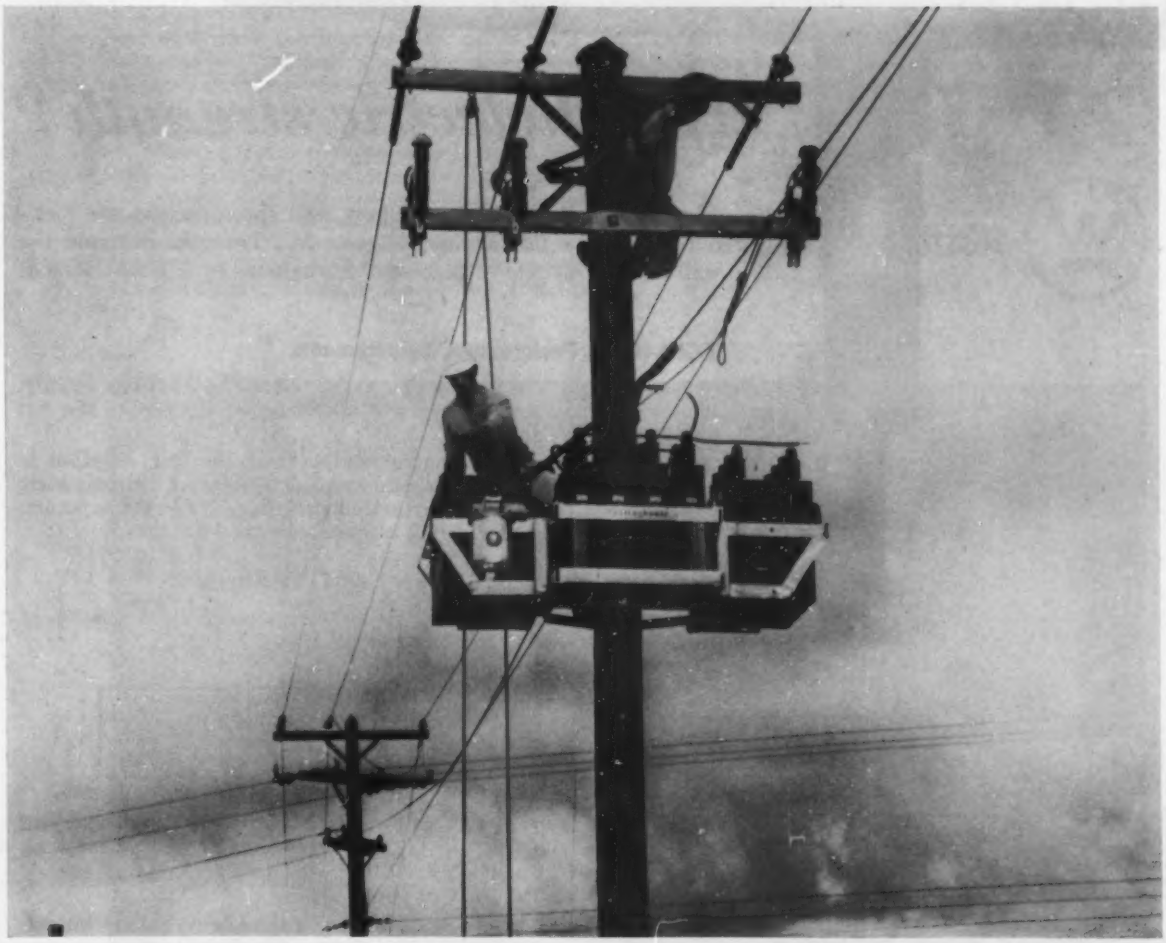

New smaller capacitors enable this utility to mount 1200-kvar banks on poles.

Underground distribution system for subdivision—page 60
Coastal line building problems—page 63
Load indicator aids distribution load management—page 64
Distribution system to carry alarm signals—page 66
Polyphase meters present verification problem—page 68
Reactor limits line-to-ground fault currents—page 69
Grounding for substations—page 72

how good should power cable be

...*for dielectric strength?*

At CIRCLE, the point is not how well specifications are met—but rather *how far they can be exceeded!* Take, for example, the well-known "double voltage test" as required by IPCEA-NEMA.

IPCEA-NEMA Performance Requirements

"6.5.3 After the sample has been immersed for at least one hour, it shall withstand for 5 minutes a test voltage which is twice the test voltage given in Table 12."

"6.5.4 . . . starting with the voltage at which the test described in 6.5.3 was made, the voltage shall be raised in steps of approximately 20 per cent of the immediately preceding voltage until failure occurs, the voltage to be kept constant at each step for 5 mintues."

"Circlesheath® Type RR Power Cable Performance"

The following table describes the performance of three samples of Circle butyl-insulated Type RR power cable.

CABLE SIZE	RATED VOLTAGE	DOUBLE AC TEST VOLTAGE	CIRCLE B'KDN VOLTAGE	MAXIMUM STRESS IN VOLTS PER MIL
2 AWG	5KV	28KV	48.3KV	454
1/0 AWG	5KV	28KV	40.3KV	356
500 MCM	5KV	31KV	44.6KV	307

A Circle power cable, subjected *for over two years* to a 250% overload of rated voltage in a *test still in process,* continues to meet all specified requirements.

Turning out high-reliability power cable requires expert knowledge of compounds, absolute quality control—and men who *know enough* to produce the very best. Next time you specify power cable, ask for Circle—there's no finer made.

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WESTINGHOUSE POWERCASTING* predicts super-capacity plants... demanding automatic operation

Load growth is accelerating. To meet demands, utilities will continue to add generation capacity in ever larger units. Accompanying the super-capacity of equipment is its increasing complexity, far greater instrumentation, mounting need for reliability.

To control this massive, and expensive, facility efficiently or even adequately is fast approaching the limits of human ability. Emergency conditions bring the problem into critical focus. Operating variables throughout a typical station number in the hundreds. It is virtually impossible for personnel to assimilate all necessary data, to analyze and translate it quickly into the best course of action. Hurried decisions based on hasty scanning of complex interrelationships by operators under great stress make the possibility of major equipment damage a constant threat. Records indicate that chances are one in three a major accident will occur in the lifetime of your plant.

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All sub-loop control systems for the turbin ator, boiler, fuel, feedwater, and all other plant are completely coordinated and integrated in

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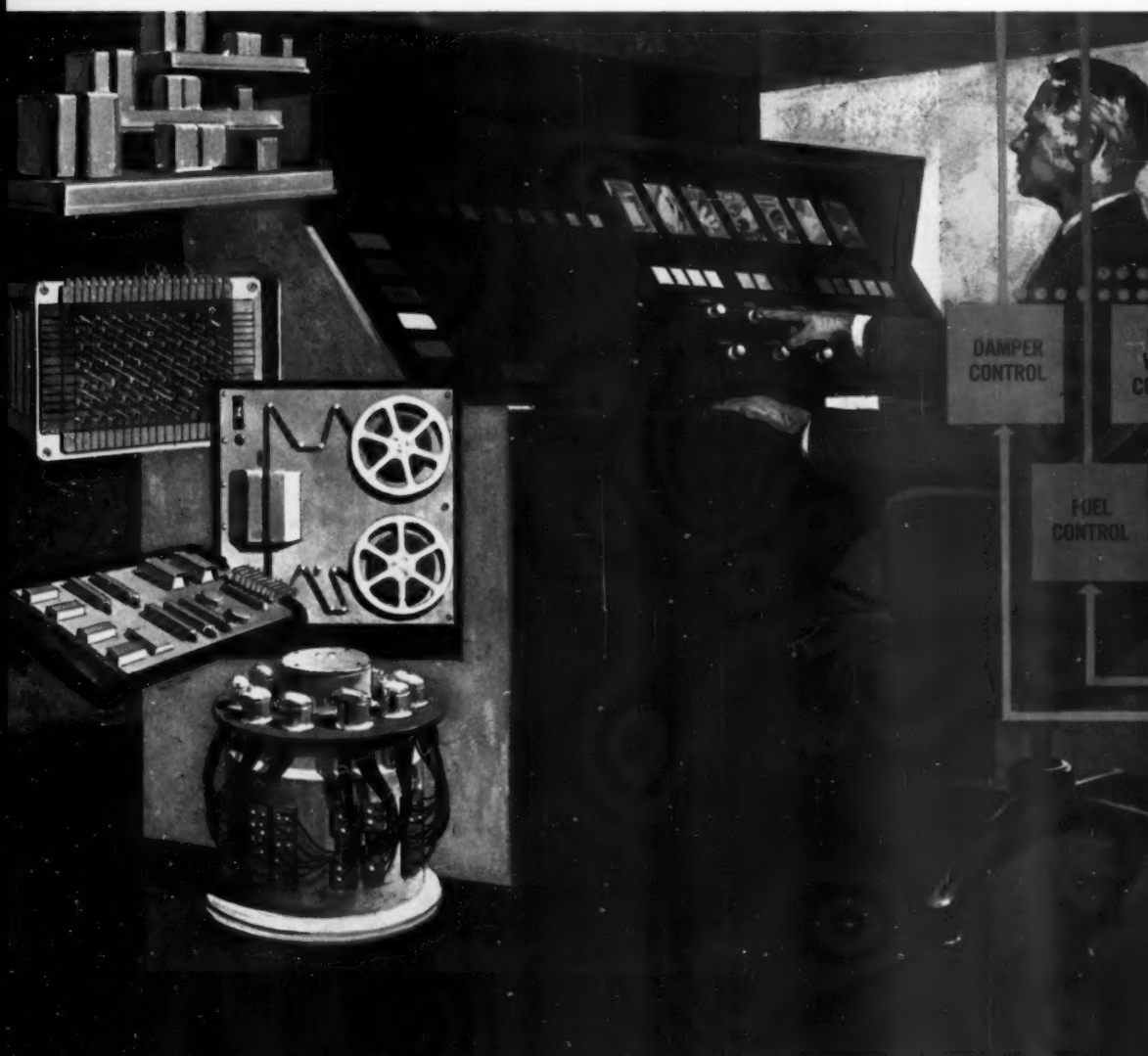

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Turbine and generator section

New sub-loop controls equip Westinghouse turbine-generators for automation.

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A wide-speed range governor, utilizing a magnetic pickup and static control equipment, has been developed for use during turbine-generator start-up. It controls shaft speed to the value dictated by the computer start-up program.

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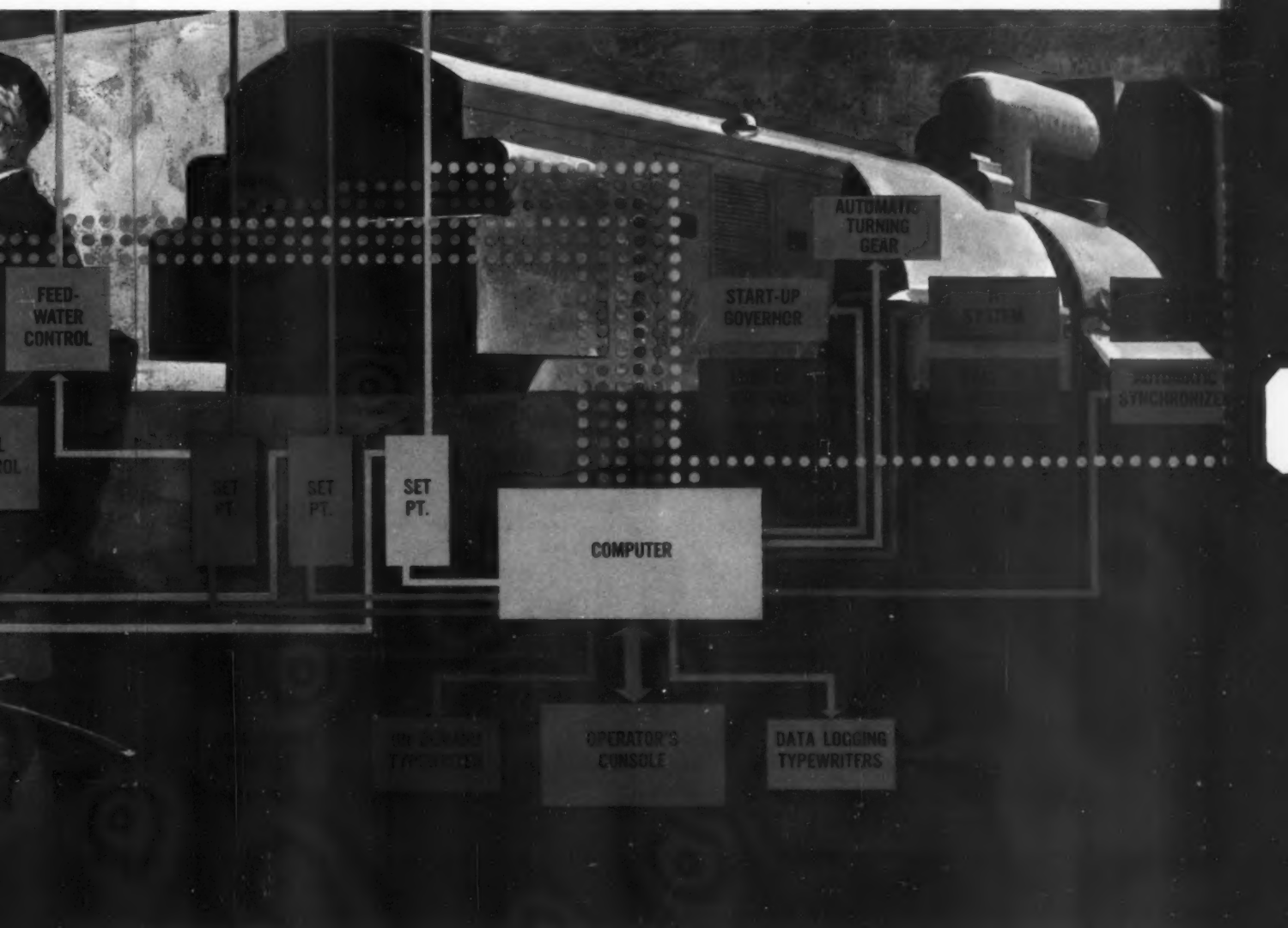

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Westinghouse experience in the special problems and objectives of the electric utility industry is broad and deep. The men in Westinghouse, having this important experience capability, will use the most advanced analytical engineering and research facilities to help Public Service be certain that all aspects of this important project have been properly coordinated.

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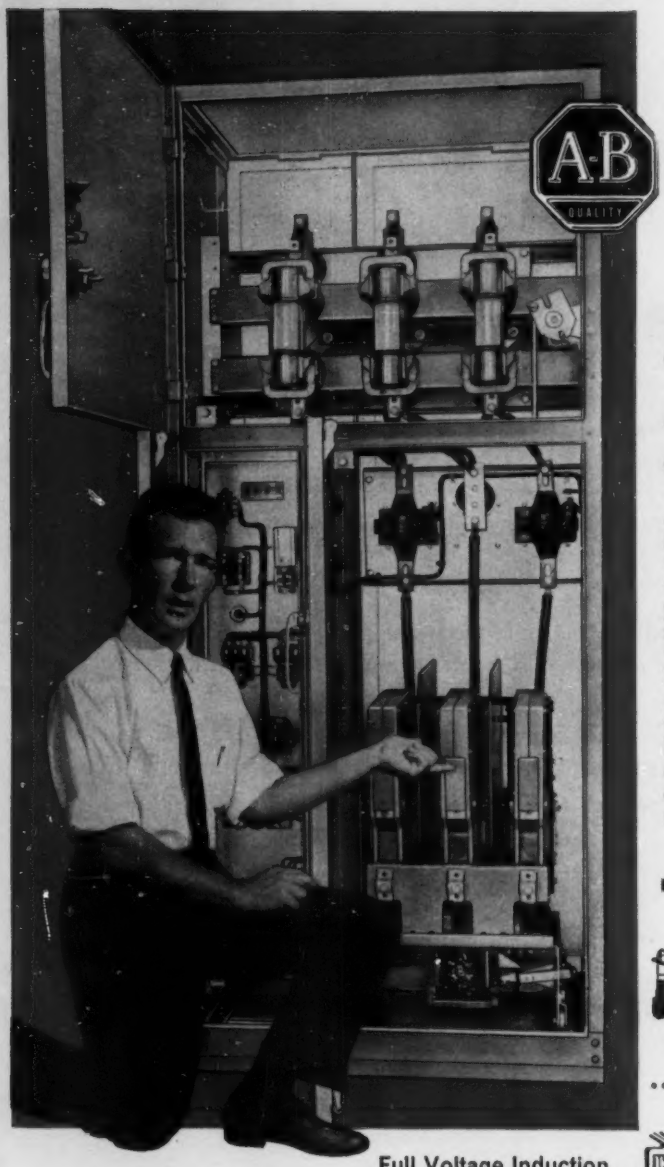

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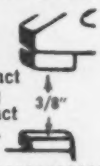

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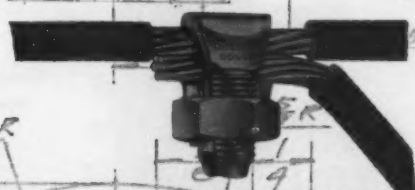
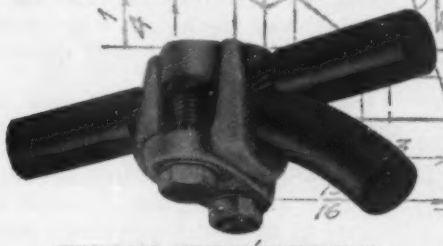


SPLIT BOLT CONNECTOR
(Type DS)
For taps, dead-ends, entrances, motor leads, junction boxes, etc.

VARIABLE TERMINAL
(Type D)
Connects a wide range of copper conductors to flat bar.



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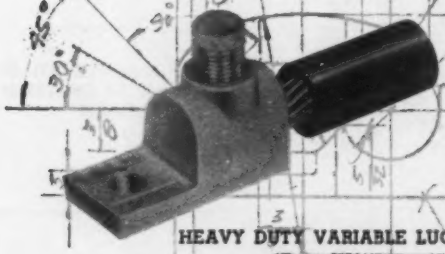
(Type DSU)
For all service cable connections. Best for larger sizes.



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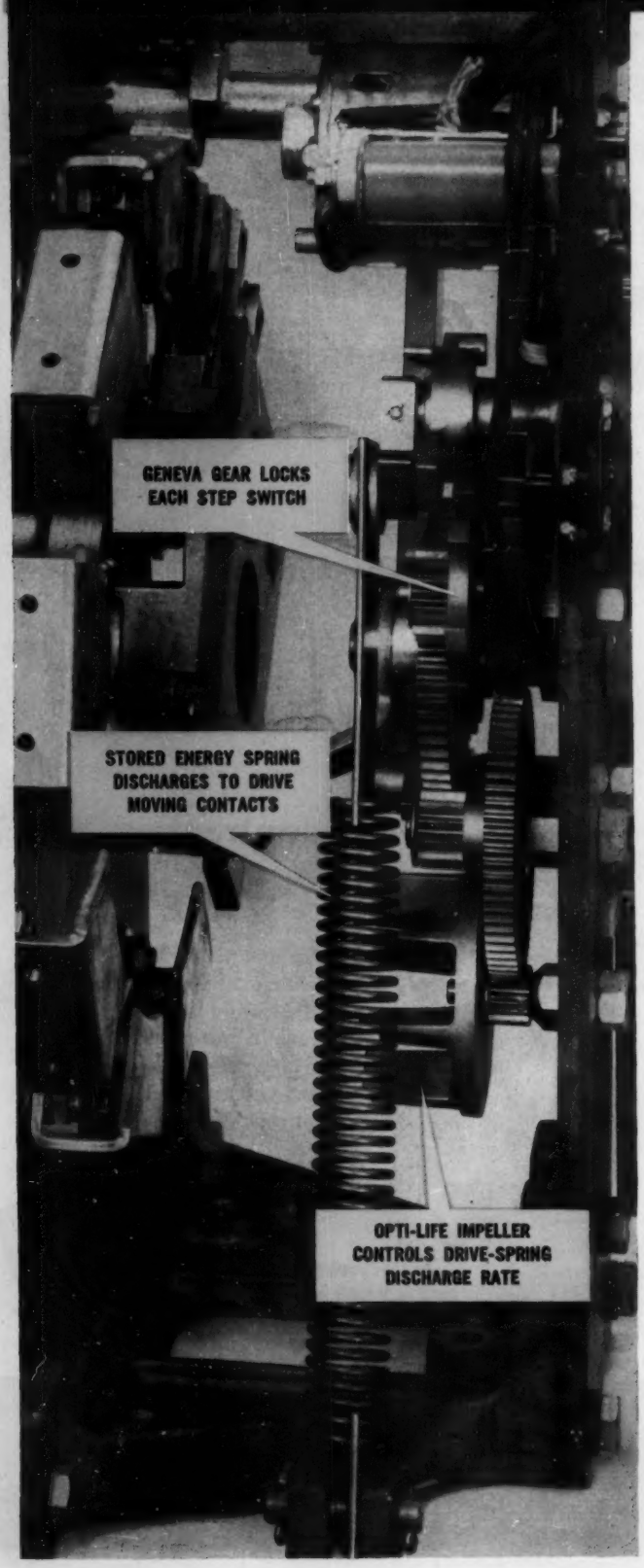
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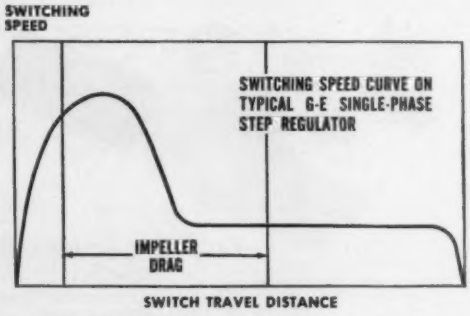
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Presently Available In Conventional And CSP Types Through 100 KVA

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7. Stronger tank top rim—obtained by rolling approximately 400° to give greater resistance to distortion when coverless transformers are lifted without a spreader and with short slings. This new rim retains our previously proved cover gasketing system in which the cover gasket fits on the top of the rim, not on the side, where it could trap oil along the top edge of the tank.

8. The three-point suspended core-and-coil assembly—prevents pressure contact of core-and-coil with the tank bottom and thus achieves a reduction in sound level. The top two points of the suspension system each consist of two conically matched surfaces, one on the framing—the other on the tankwall, on each side of the transformer. These conical surfaces are bolted together, they prevent shear on the bolt while still supporting the weight of the transformer.

9. High strength frame design—maintains eight-point blocking of coils and increases short circuit withstand.

10. Steel shipping band—connected to the lifting hook to secure the transformer on the shipping pallet and thus facilitate handling of the palletized transformer by fork lift trucks.

11. Wire bound, wooden slat protective enclosure—nailed to the pallet. This enclosure has been exhaustively pre-tested and has great strength to permit stacking. One of the advantages of this enclosure is that it may be easily stripped away, leaving only the palletized transformer. This will reduce the time required to install the transformer, and also reduce the amount of scrap material at the job site.

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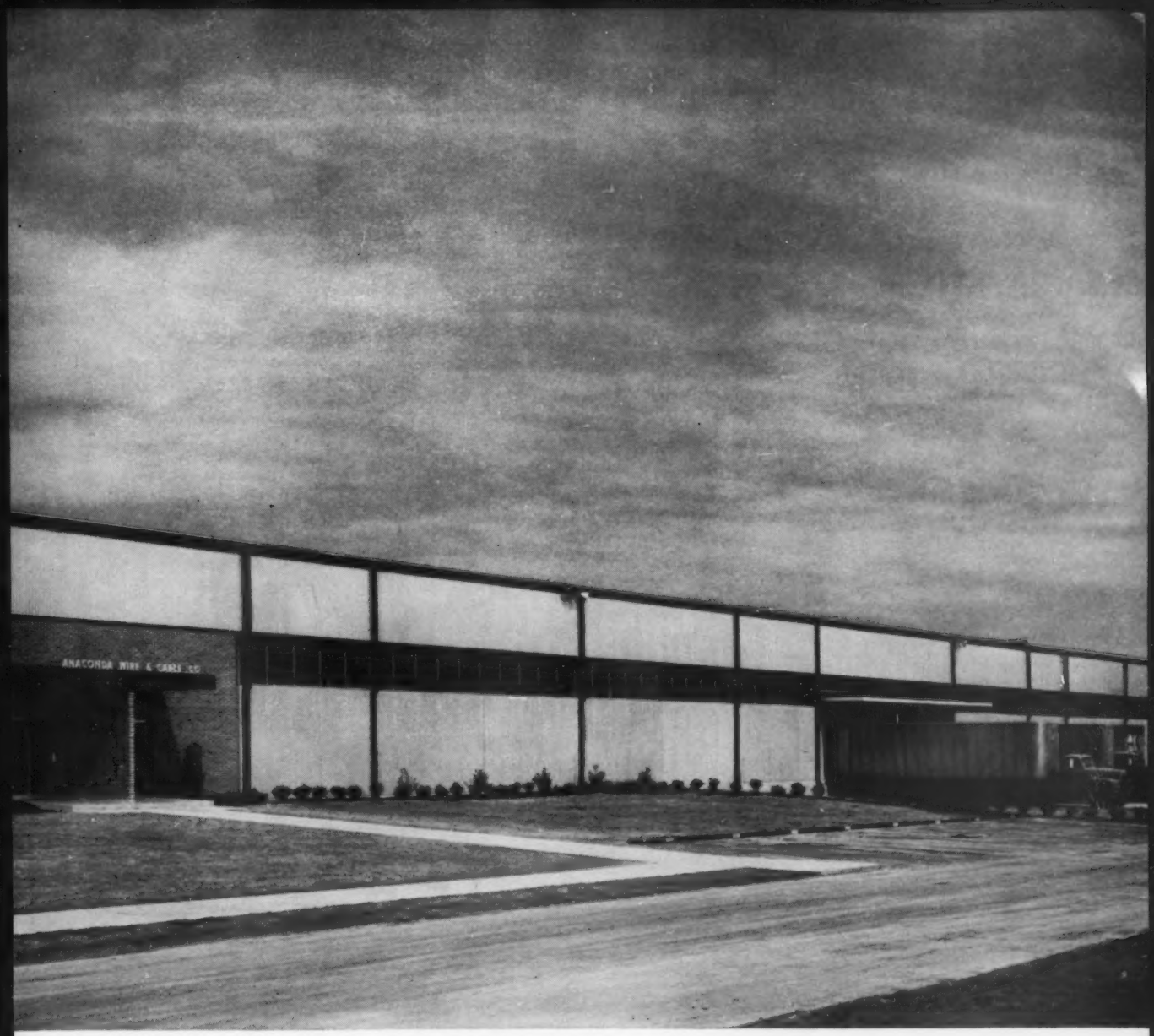

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From Public Service Co. of Oklahoma . . .

Improved Power Service To Grandfield, Oklahoma

In the Southwestern corner of Oklahoma, Grandfield lies at the end of a long 33,000 volt transmission line that starts at Lawton, Okla. 32 miles away. To bring improved customer service to this growing community, Public Service Company of Oklahoma installed a 2000 KW Electro-Motive Diesel plant in June, 1960, to provide area protection and peaking service.

New Plant Proves Its Value

The value of the Electro-Motive plant for area protection was proved only one week after its installation when one of Southwestern Oklahoma's sudden, severe storms caused a loss of power on the line from Lawton. Within 60 seconds, the Electro-Motive plant automatically started, came up to full speed and was supplying Grandfield with adequate power. Again, on August 9, during a period of peaking operation, the 33,000 volt transmission line suffered an outage due to an electrical storm. Automatically the Electro-Motive plant switched from peaking service to isolated operation to supply the area with emergency power.

Maximum Area Protection

The Grandfield area served by Public Service Company now gets maximum area protection in case of line outage because of the special dead load pick-up feature built into the Electro-Motive plant. It can pick-up a dead load with starting in-rush at five times its rated KVA and come back up to full voltage and a steady state condition in 30 seconds. And, the plant will continue to supply power for this load as long as required.

Remote Control Operation

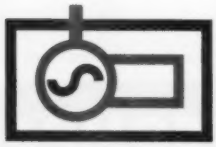
The Electro-Motive plant at Grandfield operates as a peaking unit by remote control. During periods of heavy power use, the unit can be brought on the line from a remote location. On this signal, the unattended plant automatically starts, synchronizes and goes on line in less than two minutes.

Adaptable To Many Functions

The inherent design characteristics of the Electro-Motive equipment at Grandfield that make it ideal for peaking and area protection also make it possible for Public Service Company to add additional generating units in the future to bring the plant up from 2000 KW to 8000 KW. And, they can do this at low incremental cost when load growth occurs. These characteristics of Electro-Motive plants make them best suited for many of your system requirements, too:

- fast start for spinning reserve
- automatic dead load pick-up for area protection
- unattended operation for remote peaking service
- portability for simple installation
- freedom from damage to components caused by rapid thermal changes occurring from start to full load

Available in units from 2000 KW to 10,000 KW, the Electro-Motive peaking equipment line contains both Diesel and dual-fuel plants that can permit matching the plant to exact requirements for the most economical and efficient operation at the lowest investment. Ask your Electro-Motive representative for complete details.



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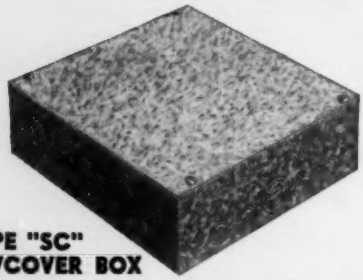

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Durable Formed Construction, galvanized or grey enamel finish, with or without knockouts. Sizes to your specifications.

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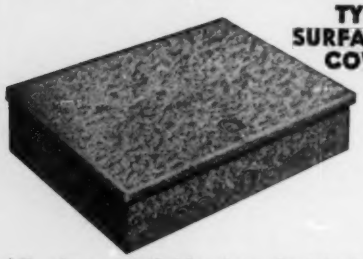

All sizes available for electrical cutouts, switches, relays, junction and pull box applications, galvanized or grey—with or without knockouts.

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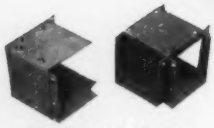

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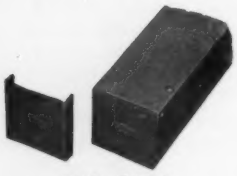
"U" CONNECTOR



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Last longer, less maintenance. Cost of the lamp itself represents only one tenth of the Total Cost of Light. The balance is power consumption and maintenance. Sylvania fluorescents not only burn brighter on the same amount of power, they last longer, require far less replacements.

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Aerial view of Bird Key, Sarasota, Florida

Underground distribution system for a residential subdivision

(This article describes some of the engineering features of the complete underground system installed recently for an extensive subdivision on Bird Key, Sarasota, Fla. Another article, describing some of the problems of the electrical contractor who made the installation, begins on page 20.)

By Harry J. Miller

◆ WHAT IS ANNOUNCED as the second largest underground electrical distribution system in the United States installed by a private contractor, and the largest such installation on the Florida West Coast, has been completed by Whitmore Electric of Miami, on Bird Key, Sarasota.

Developed by Arvida Realty Co., subsidiary of the Arvida Corp., Bird Key is a fabulous tropic isle created by dredging close to 4,000,000 cubic yards of fill from the bottom of Sarasota Bay. Brainchild of Arthur Vining Davis, Bird Key is one of the most exclusive residential areas on the West Coast. Since its 511 lots sell for $9,000 to $32,000, with homes in the $75,000 class upon them, along with a $500,000 yacht club, the developer placed all utilities underground.

While Whitmore made the complete installation of the near-$850,000 distribution system for the developer, including primary and secondary lines, Florida Power and Light assumes its ownership, paying the developer the equivalent cost of an overhead systems.

Accordingly, the system was installed to FPL's specifications as engineered through its Miami office. While the utility specified certain equipment, the contractor was accorded wide latitude in selecting materials within the framework of the company's specifications.

It had been stipulated in the contract that substitutions could only be based upon superior construction or efficiency of those components designated in the specifications. If the cost to the electrical contractor was then less, the contract price had to be reduced a corresponding amount. Documentary proof of the actual difference in cost was to be supplied, with the owner receiving the full benefit of any such cost saving.

However, in the event that the contractor won engineering approval for equipment other than that for which the system was originally laid out, then he was required, at his own expense, to make any changes needed to accommodate the equipment.

It is becoming increasingly obvious that electrical utility companies are moving to the forefront in helping their communities be more attractive. The majority have departments staffed with specialists who have comprehensive engineering know-how.

Such was the case with the local office of Florida Power and Light when service was contemplated for Bird Key. Says Manager James G. Spencer, "There is a trend for the developer to request the power company for an underground system because a neater installation makes a potent sales gimmick. Since such a system, as designed and installed by the developer according to our specifications, is understandably most costly to the utility, part of the extra expense must properly be borne by the developer."

"For example," says William Haines, FPL's division superintendent in charge of underground, "in the case of pad-mounted transformers and direct burial cable encased in concrete, cost may run three times as much as overhead service. When you go to a duct completely encased in concrete, that cost is boosted to five to seven times.

Aluminum cable selected

Probably because of his association with Alcoa, Arthur Vin-

Transformer vaults at Bird Key have hinged entrance gratings. The job meets utility specifications.

Duct heads for terminus at manhole. All duct except that at rear of lots was concrete encased.

Secondary connectors make the transition from aluminum mains to copper service cables at Bird Key.

Electrical contractors, wiring homes, pick up service at the nearest service distribution center.

This is a typical service entrance, through which three-phase service is supplied to Bird Key homes.

This $75,000 waterfront home typifies the type of residence being built at the Bird Key project.

ing Davis' organization decided that the 600-volt secondary system, which rings the island, be of aluminum cable.

With respect to this selection, Ken Daniels, FPL's district engineer, comments: "We would have preferred an all-copper installation because of the greater ease of connecting, using conventional equipments. Present high-voltage equipment is not designed for aluminum terminations with the certainty of service afforded by copper units."

Spencer further states FPL's position with respect to underground distribution systems. "If a developer seeks an underground service, he must install it under our 'specs,' otherwise he has to maintain it himself, thus nudging himself into the public utility business!"

Engineers for the Bird Key electrical system were Philpott, Ross, and Saarinen, Inc., of Fort Lauderdale, Fla. The firm's design engineer for the installation was C. E. Bailey.

Typical load established

From Mr. Bailey's point of view as a design engineer, "the objective was to provide an adequate power supply for approximately 500 lots and the yacht club with a completely underground distribution system designed to meet Florida Power and Light Company's approval, since they would be the ultimate owners.

"The starting point was establishing a typical load for each lot. From our files, we estimated the load of an above-average all-electric home to be approximately 25 kw, including six tons of air conditioning."

FPL supplied Mr. Bailey with average diversity factors which apply to this particular area for the high-class homes anticipated in the Bird Key subdivision. The diversity curve shows approximately that the 25-kw load was diversified down to 10 kw per lot for the entire subdivision. Size of the primary feeders was based on this 10-kw load per lot, and the secondary aluminum feeders were based on the load per lot taken from the curve, with the voltage drop being limited to three per cent to the last service in any secondary service circuit. A 100 per cent power factor was assumed.

Says Mr. Bailey, "We felt that the increased use of electricity, including large air conditioning motors, justified a three-phase power supply to each lot. Since the lots would be sold to the general public, we chose a 120/240-volt, three-phase, four-wire, delta transformer connection to insure proper operation of 220-volt household equipment."

Primary voltage is 13,200 volts, three - phase, four - wire, wye-grounded.

According to FPL's engineer Ken Daniels, "Some of the home buyers might want ten tons of air conditioning and we felt it desirable to prepare for this eventuality and thus save later the prohibitive cost of disturbing the underground service." The same reasoning by FPL applied to its preference of three-phase over single-phase supply.

A primary loop system assures continuity of service in case of outage. There is one main loop of three-single conductor #4/0 15-kv cables paper-taped, lead sheathed with neoprene jacket, and 15-kv grounded neutral. This main loop is sized to serve the entire subdivision for either source "A" or source "B."

Subloops are three 1/c #3, which is the minimum size used by the Florida Power and Light company, and are the same type cable as the primary. Multiple position load break oil switches in transformer vaults enable any vault to be isolated from the system without interfering with service to customers and a faulty cable or splice can be similarly isolated.

Vaults in sidewalk areas

The 32 transformer vaults are so located in sidewalk areas as to make their tops at the same elevation as the crown of the pavement. This will permit the utility company to add and change transformers from the streets, thus eliminating the requirement of a vehicular easement along the rear lot lines.

A type 1 vault is 14 feet long, has spacious headroom, and is suitable for only two transformers up to 167 kva. A type 2 vault, two feet longer, will accommodate a trio of transformers up to 167 kva. The larger vaults were specified in Bird Key waterfront lots where larger electrical loads are anticipated.

Actual transformer sizes will be determined by the local utility to serve the connected load, as the subdivision develops. With each vault equipped with a sump pump, the combination of subway type transformers and watertight wiring is such that if the entire system should be submerged in water, there will be no interruption in service.

"Due to maintenance problems experienced with direct buried cables in this section of Florida," says Mr. Bailey," "all primary and secondary cables were installed in four-inch ducts. In the street right-of-way, concrete-encased fiber ducts were used for protection from traffic. Along the rear lot lines, direct buried transite conduits were placed. One spare duct was provided in each duct bank containing either a primary or secondary circuit, while two spares are in those duct banks containing both primary and secondary circuits."

Concern felt by FPL

In retrospect, some concern is felt by FPL with respect to the non-concrete-encased duct at the lot lines. These are admitting water and opinion is that the ducts are picking it up by absorption, "otherwise we'd have had a 100 per cent bone-dry system. It's already a problem and it'll probably continue to be a future aggravation," said one utility official. Since these duct runs are 200 to 250 feet long, it was deemed impractical to uproot them at each lot and reinstall them in concrete.

"Had we ourselves been doing the job, we'd have changed this, but you can't do that easily with a contractor who has turned in a bid to make the installation a certain way," said the FPL official.

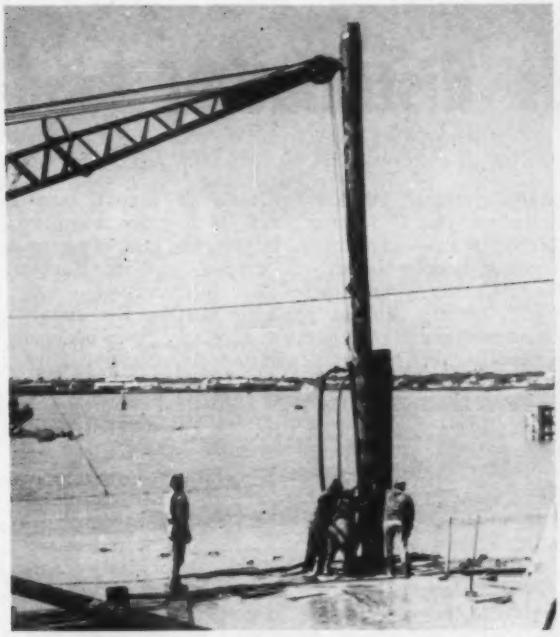
He also points out another weakness in the utility-contractor relationship. Some of the transformer vaults are built with soakage pits from which the sump pumps extract the water and dispose of it through storm sewers. But in extreme wet weather those soakage pits not so equipped with a sewer discharge will pump the excess water over adjacent lawns.

"Considering the residents of Bird Key, this is bound to develop into an aggravation to FPL," said the official.

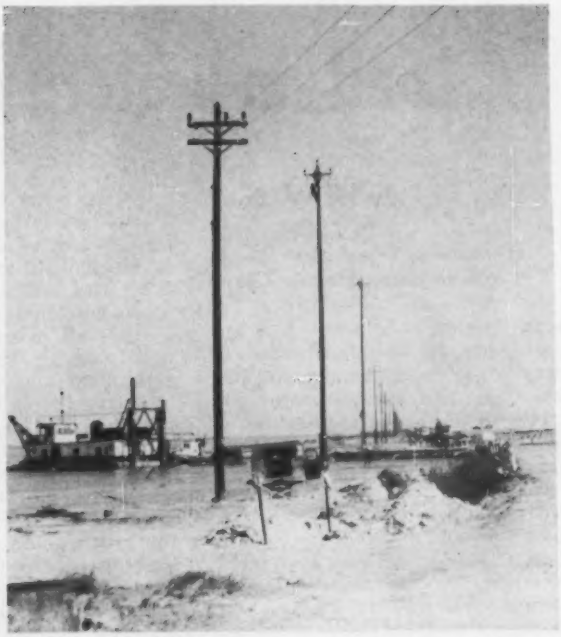
Underwriters' approved type USE style RR cable forms the 600-volt secondary system at Bird Key. On a similar project, an alternate bid using aluminum as secondary proved it had an economic advantage over copper conductors. However, aluminum poses a terminating problem.

Since the engineering firm felt it was desirable to use the standard pre-insulated multiple copper connectors in the handholds, this

(Continued on page 134)



Poles are fastened to heavily treated piles in coastal area where poles are actually set in water.



45-kv fog-type insulators and 4/0 copper conductors are used on 7.2/12.5 kv line across Red Fish Bay.

Coastal power line building problems

Barge mounted crane supports 85-foot pole while it is fastened and banded to heavily treated pile.

By O. A. Boyer

Distribution Engineer
Central Power and Light Co.
Corpus Christi, Texas

◆ SOME UNIQUE construction situations were encountered recently by the transmission and distribution department of Central Power and Light Co., of Corpus Christi, in connection with a power line built over land and water along the coast.

Central Power and Light Co., serving a greater portion of the Texas Gulf Coast area, encounters many installation problems that are unique. One recent experience concerned the building of lines across an expanse of alternate water and land areas to the Harbor Islands and Port Arkansas areas, near Corpus Christi.

Construction of these lines was by the standard land and water transportation methods. It was unique, however, because none of the land traversed was more than five feet above mean high tide, with much of the surface too soft to support land equipment, and the depth of water crossed was a maximum of 12 feet.

Much of the land was soft and not suitable for digging holes for normal pole settings. In these cases, piling was driven and the poles anchored to the piling.

Heavy piling treatment

It was necessary to treat the piling with a much heavier preservative treatment than is normally given poles, with special combinations of treatment to combat the various fungi and marine borers that are prevalent in this area.

Refusal retentions of 70-30 creosote, coal tar solution were used for the treatment of the piling and 10-pound retention #1 creosote was used for the treatment of the poles. All poles and piling were of Southern yellow pine.

It has been found by past experience that the heavy treatment is not suitable for use on the poles where men must climb and the lighter treatment is not suitable for the pilings that are subjected to marine borers, particularly teredo and limnoria.

The poles are placed above mean high tide and are banded

(Continued on page 133)

Load indicator aids distribution load

By H. W. Book
Design Engineer
Distribution Transformer Dept.
Westinghouse Electric Corp.

◆ INTRODUCTION of a new load indicator concept to the distribution transformer field promises to add new vigor and remove major obstacles to the broad application of such devices as a load management tool.

The new "TL" indicator, currently being introduced by Westinghouse, will make it possible to apply load-monitoring devices selectively across an entire operating system, with a minimum of cost, time, and inconvenience. The improvement in operating economies resulting from more positive transformer load management promises returns considerably in excess of the investment and effort required.

Load management — why?

Central station operating efficiencies have long been considered of major economic importance. Today even small incremental improvements in generator performance or loading techniques receive wide notice.

At the other end of the system, a similar large investment has been made in distribution transformers. Until recent years, however, the loading of such equipment was limited by the effects of thermal overloads and voltage regulation. It was generally not considered possible to load distribution transformers to the level indicated by economic analyses.

Recent major improvements in transformer thermal endurance and improved regulation through lower impedances have changed this picture. As a result, a fresh look at distribution transformer economies had made the industry aware of the great potential of this previously unattainable source of cost reduction and revenue improvement. Even modest gains in this operating area can be measured in millions of dollars to the electrical industry.

The "know-how" for effective load management of distribution transformers involves no magic. The basic knowledge required, a simple economic analysis of the effects of loading on costs and revenue, is not difficult to develop with a reasonable degree of accuracy.

Special knowledge of the nature and magnitude of actual transformer loads is a more complex problem. In fact, the lack of agreement on proper load-monitoring methods has discouraged many from pursuing further the apparent gains in economy. Two general approaches to the problem have been made.

(1) **The statistical approach**— Feeling that the quantity of units involved dictates the use of an "impersonal" statistical approach, a number of utilities are studying this method, making widespread use of the electronic computers required to make such a study feasible. In some reported cases, a very complex computer program has been developed to correlate and summarize the great volume of data available from metering records, connected-load surveys, and growth studies. High correlation factors are reported by some proponents.

(2) **The load indicator approach** — Feeling that the constantly changing and highly individualistic load patterns for distribution transformers require a "personal" approach, many companies, large and small, are actively studying the feasibility of load management by means of a load-monitoring de-

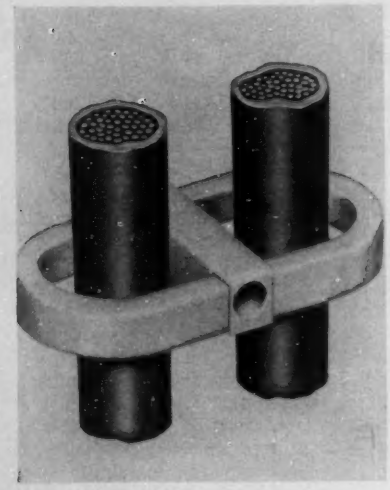


Fig. 1—Within the load indicator is located a magnetic structure similar to a current transformer.

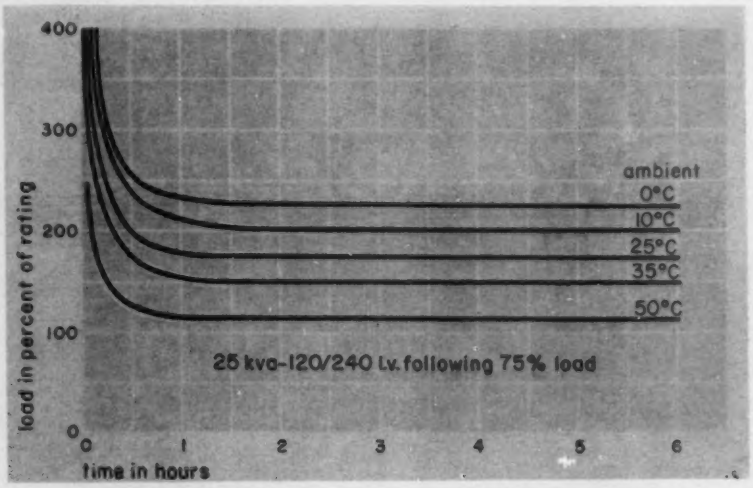


Fig. 2—Fast response and variation of indication with extremes in ambient temperature are shown on this "load-time" curve. A calibrated knob permits field adjustment of the operating level if desired.

vice on each unit. Some utilities have already adopted this system, using the overload signal light found on most self-protected (CSP) transformers. Results are reported well correlated with more elaborate load studies.

Each of these approaches and their variations have well demonstrated merits and weaknesses. Each can claim enthusiastic advocates. As no single system appears to hold all the answers, it is indeed possible that several such approaches, or a combination of them, will find wide acceptance. The great variation in load practices and operating philosophies among operating companies would suggest this result.

Regardless of the system adopted, it must fully satisfy two basic requirements:

(1) It must provide the information required at a reasonable per-unit cost, with a minimum of effort and a maximum of confidence and flexibility.

(2) It must be capable of widespread application over a reasonably short period without undue cost and inconvenience to system operations.

It is this second requirement that has most seriously restricted the widespread application of the indicator system beyond the CSP field mentioned earlier. Available indicators possessing the degree of accuracy required under operating extremes were of a type requiring factory or shop installation. Widespread use on a system was at best a long-range proposition. It was to meet this basic need that the new, general purpose "TL" load indicator was developed.

Transformer load indicator

A low-cost indicator, operating completely independent of the transformer, was made possible by applying a principle as old as the transformer itself. Even remote load monitoring is possible. The "TL" indicator does not depend on thermostats buried in the transformer winding, nor does it attempt to correlate load with oil temperature, or its distant relative, tank temperature.

Instead, the new indicator derives its response characteristic from the magnetic field surrounding a current-carrying conductor in a way analogous to a common current transformer. The influence of the fluctuating field on a "magnethermic" element located within the indicator results in a tailormade response to transformer load.

It is a well-known and often distressing principle that subjecting a ferromagnetic structure to an alternating magnetic field results in losses and heating in that structure. In the "TL" indicator, this principle is put to work.

Within the indicator is located a magnetic structure shown in a

(Continued on page 131)

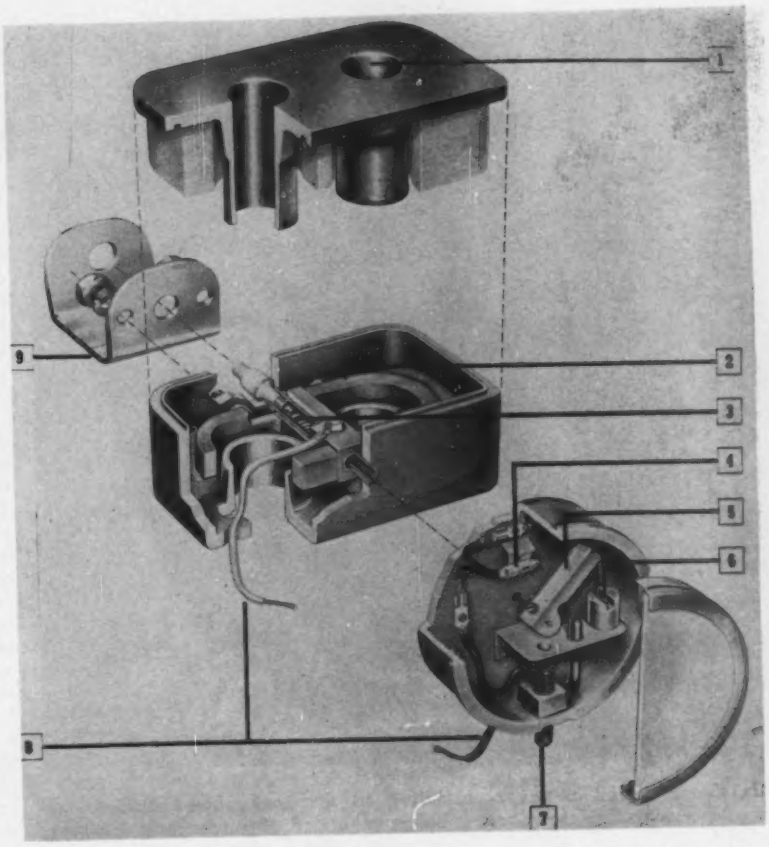
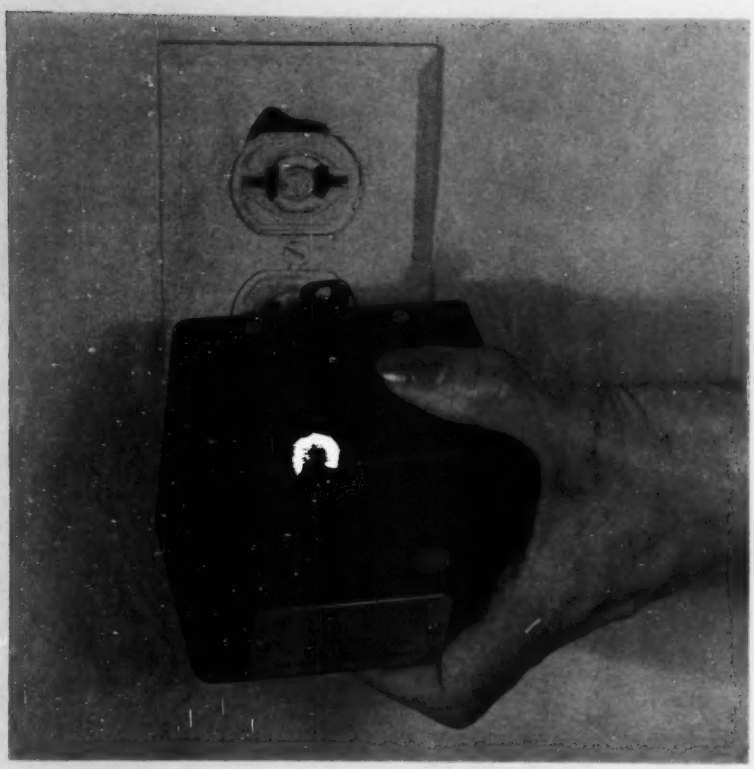


Fig. 3—Operation of the basic "TL" indicator is shown in this cutaway view of the internal mechanism. Heart of the indicator is (2).

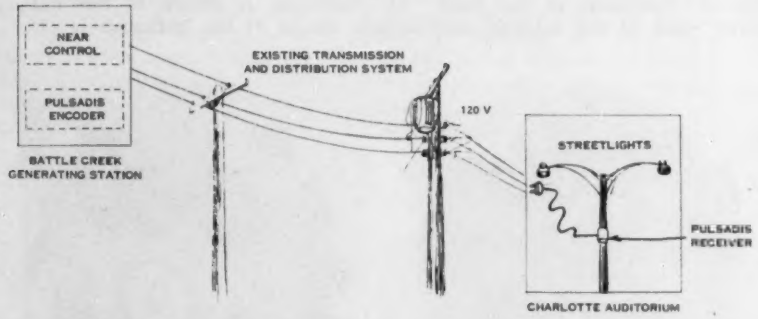
Fig. 4—Line leads can be passed through the two holes provided.

Fig. 5—The indicator is shown attached to a 25-kva transformer.

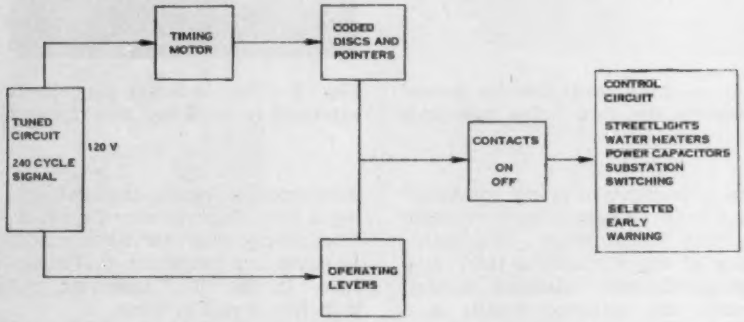
Distribution



This alarm signal receiver, installed in any convenient outlet, can provide a warning signal to a home or office of impending disaster.



This schematic representation of the coded receiver equipment shows how the system was demonstrated recently on a typical power system.



A simplified block diagram of Pulsadis receiver operation shows some of the other uses which can eventually be made of such a system.

◆ MORE THAN 300 power company officials and engineers, military and civilian defense officials, members of Congress, industrial executives, and technicians witnessed the first mass demonstration of the National Emergency Alarm Repeater (NEAR) System in October.

This demonstration held particular interest to the utility engineers not only because the utility distribution system serves as the medium over which the alarm signals will be transmitted, but also because much of the equipment demonstrated will have practical application on the utility systems as a method of controlling capacitor switching, street lighting, off-peak water heater loads, etc.

Held in Charlotte, Michigan, the demonstration took place when a warning signal was received which originated from a military detection outpost near the North Pole. The signal was flashed from the outpost to the North American Defense Command headquarters at Colorado Springs, Colo. After receipt there and evaluation at NORAD, it was relayed immediately over the national warning system of the Office of Civil and Defense Mobilization, which is located in Battle Creek. The demonstration was conducted over the power lines of Consumers Power Company, of Battle Creek, and transmitted 28 miles from Battle Creek to Charlotte, where it turned on street lights placed in the Charlotte High School auditorium, where the audience was assembled.

The National Emergency Alarm Repeater system is a new indoor warning device sponsored by the Office of Civil and Defense Mobilization. It operates from a signal created by special generators on commercial electric power lines. The device itself is a small metal unit about the size of three packages of cigarettes. When activated, it produces a loud distinctive buzzing sound. Neither the alarm device nor the activating signal has any effect on the normal operation of electric power in the home.

Generators were installed under the direction of the Midwest Re-

system to carry emergency alarm signals

search Institute of Kansas City, Mo., who worked under contract with OCDM on the project. Two thousand of the NEAR receivers were manufactured by the A.C. Spark Plug Division of General Motors.

Reliable home warning

OCDM Director Leo A. Hoegh said at the demonstration that the NEAR system appears to offer the greatest potential for reliable home warning because it can send a signal throughout the nation in less than one minute from a single warning point. He pointed out that this can be done automatically by repeating the signal from one power company to adjacent power systems once the necessary generators are installed.

The generators involved in the system can be placed in existing power company substations so as to convert a small portion of the normal 60-cycle current to the 240-cycle warning signal, which is used to activate the devices.

Low frequency injections systems using coded receivers on electric utility power lines are relatively new in the United States, but they have been used on electrical systems in Europe and Australia for many years. Approximately 500,000 coded receivers are now in use in France and other European countries for control functions.

Signal inductor

The "heart" of the NEAR system is the signal inductor, a device that resembles a substation transformer, but acts, under intricate electrical circuitry, to coax a special harmonic current from a standard 60-cycle power system.

It is the voltage associated with this special current—240-cycle—that trips an alarm device at home to warn of impending disaster.

Developed by Midwest Research Institute, the inductors installed at Battle Creek and Grand Rapids were designed and manufactured by the General Electric Company's medium transformer department.

Here is how they work, according to company engineers:

When energized for signaling, the inductors draw an exciting current which has a 240-cycle component. This current, flowing through system impedances, produces a 240-cycle voltage which "rides" on the 60-cycle wave in all directions, tripping, after a preset time delay, alarm receivers in all homes within a 40- to 50-mile radius; under some circumstances up to several hundred miles.

The NEAR signal travels through conventional transmission lines and associated power equipment with no interference to the flow of commercial power.

Key to NEAR's performance is the ability to equip inductor banks to respond to the 240-cycle signal. Master banks can send signals up to 100 miles away that can trip receivers in "follower" inductor banks, energizing them for signal operation.

After receiving this signal, each bank of "follower" inductors produces a continuous signal to activate home receivers. In this way, signals can travel across many power systems and reach every home within minutes.

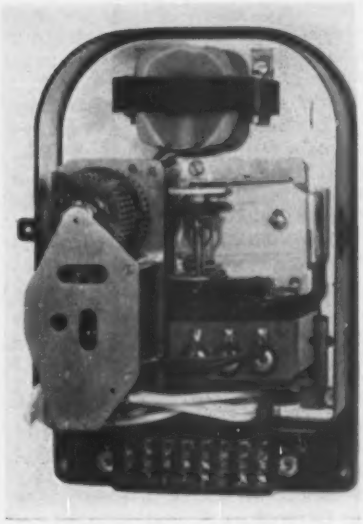
The first three-unit bank of inductors was installed in January, 1959, at the Consumers Power Company's Elm Street (Battle Creek) substation. It performed fully up to expectations, producing a signal of desired strength.

Engineers, however, were concerned with the electrical power losses experienced during standby operation (to be ready for emergencies the units must be energized on standby). In April, 1959, Midwest and General Electric engineers held a conference.

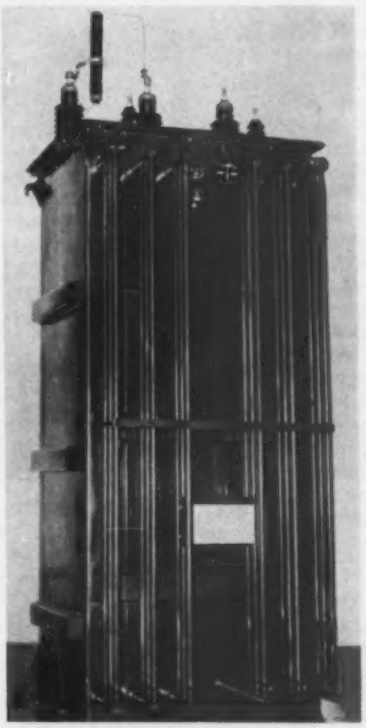
New design evolves

Out of that meeting came a new design that cut down standby power losses, while still giving high signal strength during operation. Three units, incorporating the new design, were delivered by G.E. to Grand Rapids in June, 1959, and were successfully tested by September of that year.

Present design calls for three single-phase inductors in each bank. The high-voltage winding in each is connected to the power system, and a biasing winding is connected to a direct current supply to saturate the core in one



The Pulsadis low frequency coded receiver with cover off. It operates from a 240-cycle signal.



Three of these assembled inductors are needed to provide the warning signal over a 50-mile radius.

direction to produce the desired asymmetrical impedance.

On standby, the NEAR installation appears to the utility electrical system as an unloaded transformer bank. During signaling, a direct current in the biasing winding saturates the core in one direction to produce the desired non-linear exciting impedance which causes the 240-cycle component in the exciting current.

As a part of the demonstration, Sangamo Electric Company furnished a coding device which actuated the NEAR generators and a coded receiver known as the Pulsadis relay.

The Pulsadis relays used for the Charlotte demonstration were manufactured by the Compagnie des Compteurs of Montrouge, (Seine) France, a leading manufacturer of electrical equipment for many years.

Sangamo has been investigating frequency injection systems and coded receivers for utility applications and has worked in close co-operation with the Compagnie des Compteurs. The signal encoder for operating these relays was developed and manufactured by Sangamo.

Following is a brief description of the coded Pulsadis relay. When the receiver is connected to a 120-volt line, the tuned circuit of the receiver is sensitive only to a fourth harmonic or 240-cycle signal. When an initial signal pulse of correct frequency is received, a synchronous motor timing mechanism is activated. The timing motor drives coded discs with attached pointers through a timed cycle. The coded discs are keyed according to the desired signal. A complete signal consists of a starting pulse and a timed space operating pulse.

After the starting pulse is received, the second operating pulse causes an operating lever to be moved by a pointer on a coded disc. The operating lever either closes or opens a contact, depending upon the switching function desired.

Receiver can be coded

The Pulsadis receiver demonstrated by Sangamo can be selectively coded for 40 separate functions through various combinations of signals. Many utility applications for coded receivers are apparent. Control of street lights, water heaters, power capacitors, substation switching, etc., is ideally suited for a coded receiver instrument. Selective warning of various echelons of government and military personnel can also be accomplished with a coded receiver system.

It is theoretically possible that a coded receiver system could be used for both selective warning and utility application.

Future application of coded receivers in this country for power capacitor switching, street light and water heater control, etc., is seen as an imminent possibility. NEAR has the capability of warning 98 per cent of the nation's population within minutes of an approaching disaster, whether it be a ballistic missile, tornado, or flood.

Polyphase meter installations present verification problem

By R. C. Ashe
Division Meter Supt.
Georgia Power Company
Athens, Ga.

◆ INVARIABLY, when a utility meter installer puts in a polyphase meter installation, service is given before the electrical contractor and the customer are ready for it, and therefore no load is immediately applied. This presents a problem of verification to the meterman who is satisfied only when he sees the meter operate properly with the customer's load.

In the past it has been the practice to check the installation as completely as possible when the installation is completed, leave the installation, and return after a sufficient time which has enabled the customer to complete his work and apply load. Many times this is a matter of days while other times it is a matter of weeks. Many times the extra trip is nearby but other times it is scores of miles. The problem, therefore, is wasteful in time and is expensive to a utility's operation. It is necessary, however.

Errors occur

Although errors are rare, they nevertheless happen. Polarity errors in instrument transformers are not common, since the manufacturers as well as the utilities have modern and expensive equipment to verify and check instrument transformers. Errors in polarity do occur, however, and when they do a great deal of revenue is lost because of the high consumption that is involved when instrument transformers are used.

Mistakes in wiring are rare but can happen with the same loss in revenue as outlined above. Many other possibilities such as broken cable, defect in meter occurring after test, defect in instrument transformers occurring after test, or any number of remote errors might occur. These could fail to draw the attention of a meterman until he saw the operation of the meter under an actual load.

A possible solution

In order to solve this problem of verification it is suggested that a three-phase resistance load of five to nine kw or more be made and provided with leads and clips that could be connected across the customer's switch. This load would be developed using three electric oven units placed together and connected to form a three-phase load. One load for 240-volt operation would consist of three 240-volt oven units connected in delta and the second unit would consist of three 240-volt oven units connected in Y for 480-volt installations, and each properly fused.

Admittedly, the meter will turn slow at a load of five to nine kw, especially so when 800-ampere current transformers and 480-volt potential transformers are used, but even here there will be eight to 14 watts on the meter and only approximately two watts are needed to start the meter. The purpose of this load is not to test the meter but only to observe its motion.

Backward running meter

In some cases a customer's load may have such a low power factor that a correctly connected meter will under some conditions run backward. This is always a source

(Continued on page 133)

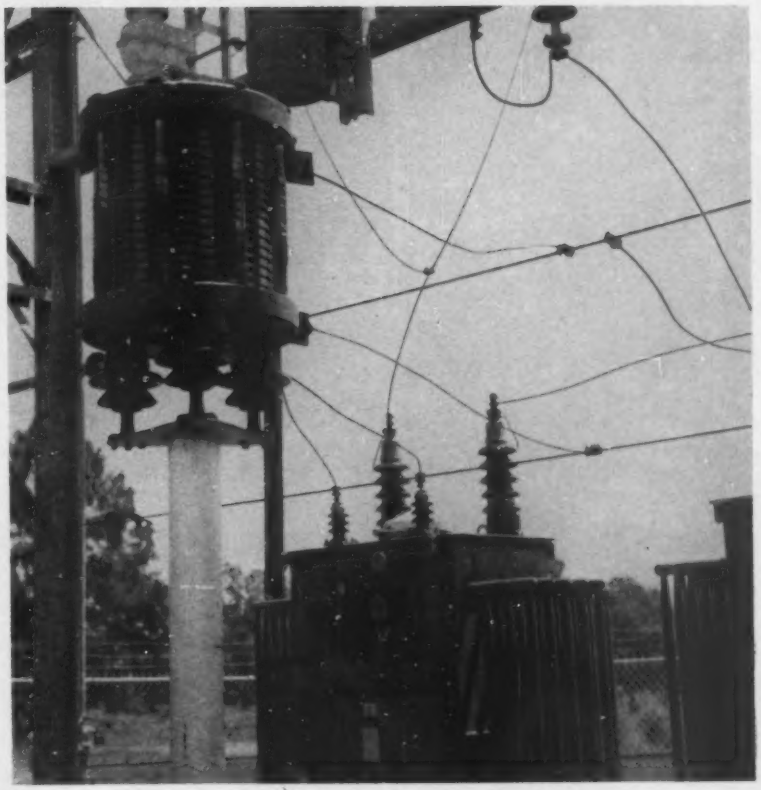
Reactor limits line-to-ground fault currents

By Bennett Rutherford
Manager
West Florida Electric Cooperative
Graceville, Fla.

◆ A FIVE-OHM REACTOR has been used by the West Florida Electric Cooperative in Graceville, Fla., to limit line-to-ground fault currents on its rural distribution system.

In 1953 it was decided to increase the capacity of the Graceville Substation from 2,000 to 3,750 kva. One of the first problems that presented itself was the unusually large fault current that would be produced. There were approximately 20 oil circuit reclosers located within two miles of the substation.

These reclosers were 50-ampere capacity with a maximum interrupting rating of 1,200 amperes. Preliminary calculations ascertained that the maximum fault currents would exceed 1,200 amperes at all of these locations. Approximately half of these reclosers were located on single-phase taps and would only be subjected to line-to-ground faults. It has been our experience that more than 95 per cent of the faults that occur on our system are line-to-ground.



This five-ohm reactor, connected in the neutral of the Y-connected circuit, serves to limit primary line-to-ground fault currents.

Limit fault currents

It was decided that instead of purchasing larger reclosers at a higher price, it would be better to keep the present ones and to limit the maximum fault currents to a safe value. The natural choice was reactors. However, the placing of reactors in the line conductors would not only limit the fault current but would cause an undesirable voltage drop that would outweigh the benefits to be derived from the reduced fault currents.

It is known that in a three-phase four-wire Y connection there is no current flowing in the neutral on ordinary balanced loads. With the increasing length and number of three-phase lines that lead from a substation it is becoming very easy to achieve almost perfect load balance.

If a reactor is placed between the neutral of the Y connection and the grounded neutral of the system there will be no voltage drop across the reactor on balanced loads. However on a line-to-ground fault the voltage across this reactor can be several thousand volts, depending on the magnitude of the current. Experience proves that more than 95 per cent of the faults are line-to-ground and the fault current will return through the neutral conductor. By placing a reactor of the proper impedance in the neutral connection this line-to-ground fault current can be limited to a safe value.

For our particular application it was found that a five-ohm reactor would limit the line-to-ground fault current to approximately 1,000 amperes under maximum conditions. A ten-ampere load unbalance will cause a voltage drop across the reactor of approximately 50 volts.

When an impedance is inserted in the neutral of a connection of this kind it is possible for a high voltage to appear on the unfaulted phases during the time that fault current is flowing. These voltages can cause spill over at the arresters if the value of the impedance is too high. Calculations showed that these voltages would not be excessive. To our knowledge no damage has been caused by high voltage during faults.

Five-ohm reactor used

A five-ohm reactor was placed in the neutral of the Graceville Substation as shown in the photograph. At that time the total installed cost was approximately $800. The installation can be ac-

(Continued on page 132)

20 years beneath the sidewalks of New York USS Tiger Brand Paper-Lead Cable

Like most utilities, Consolidated Edison of New York City, is engaged in an endless race to keep up with the growing demand for electric power.

In the Williamsburg section of Brooklyn, new USS Tiger Brand Paper-Lead Cables were installed to replace some of the existing ones that were being removed, due to system rearrangement, after 20 years or more of service. In some areas, the new cables were an addition rather than a replacement. The old cables were still giving good service but additional capacity was needed.

USS Tiger Brand paper-insulated, lead-sheath cables are noted for their reliability. More than 56,000 feet were used by Consolidated Edison in recent expansion programs. Engineering specifications called for 2/0, 27 KV, 3-conductor cable in carefully predetermined lengths for the Williamsburg section.

For high-voltage feeders, USS Tiger Brand Paper Insulated Cable is available in solid or gas-filled types. Many special constructions are available as standard production. An inquiry detailing your requirements will receive our prompt and careful attention. Write American Steel & Wire, 614 Superior Ave., N.W., Cleveland 13, Ohio.

USS and Tiger Brand are registered trademarks

USS Tiger Brand Electrical Wire & Cable —A standard cable for every special job

Asbestos Wire and Cable • Varnished Cambric Cable • Mold-Cured Portable Cord • Interlocked Armor Cable • Shovel & Dredge Cable • Special Purpose Wire & Cable • Paper & Lead Cable • Aerial, Underground and Submarine Cable

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors • United States Steel Export Company, Distributors Abroad

Power boost for Williamsburg area. Crew makes a 393-foot pull applying lubrication on the new Tiger Brand Cable as it is fed into the underground duct.

Grounding for substations

Second of two articles on principles and practices

By C. H. Jensen

Chief Electrical Engineer
Copperweld Steel Company
Glassport, Pa.

◆ THE CHART, Figure 5, shows some test results obtained from actual installations of rods driven in different sections of the country. The data for plotting this chart were obtained by measuring the resistance after each rod section had been driven and the curves, therefore, show the resistance at various depths. In all cases, as the rods were driven, the actual rate of decrease in resistance is greater than the theoretical. This indicates that the better conducting soils lie at the deeper levels.

At some locations it was necessary to drive to a considerable depth in order to reach the lower resistance soil, while at others shorter rods were adequate to provide a safe ground. Hundreds of installations of this type were made in practically all sections of the East, Middle West, and South and, in general, the resistance-depth curves show the same trend as indicated in this chart.

The preceding charts show the desirability for driving one or several rods at a substation site. Such tests will provide preliminary information on the average resistance of a single rod and also the depth to which rods can be driven at a particular location. If sectional rods are used for this purpose and measurements are made after each section is driven, information can be obtained that will be of further assistance in the design of a station ground.

With information as to the average resistance of a single rod available, and having estimated the desired resistance of the station ground field, it is possible to determine the approximate number of rods that will be required for the substation under consideration. Since such grounds usually consist of a considerable number of rods connected in multiple, the combined resistance will be dependent upon the paralleling effectiveness of the individual rods.

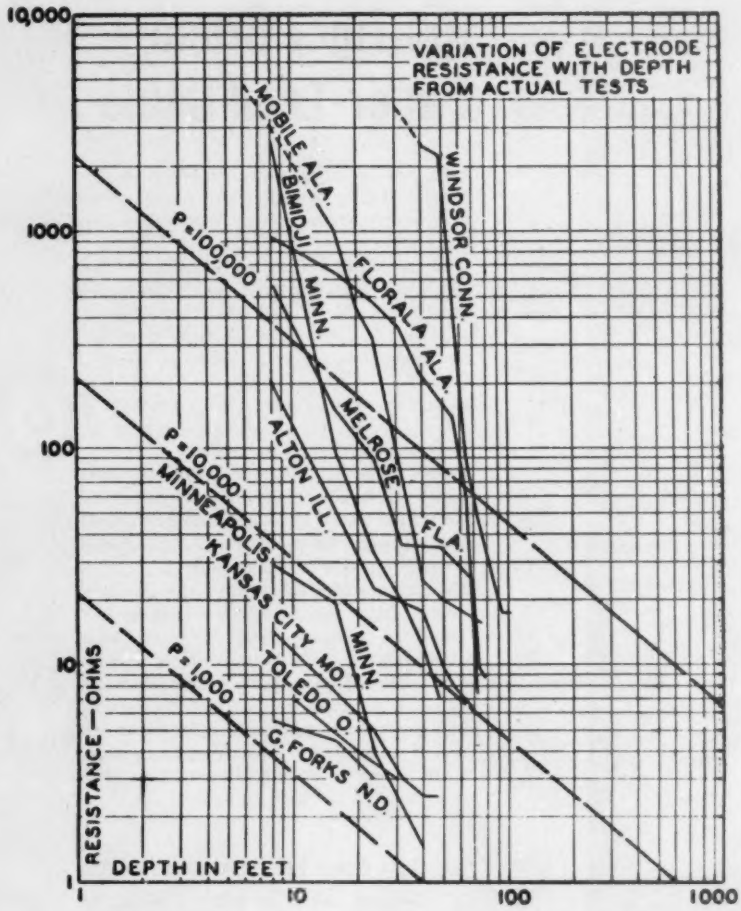


Fig. 5—How electrode resistance varies with actual depth is shown from test results of actual installations in different cities.

Limit to number of rods

Available data show that the effectiveness of rods in parallel decreases as the number of rods is increased. There is, therefore, a practical limit to the number that may be driven in a given area. This results from the fact that as the number of rods in a given area is increased, the spacing between electrodes decreases.

The cylinders of earth surrounding the rods, which determine the resistance of a ground, tend to overlap, thus decreasing the effectiveness of the individual rods when connected in multiple. Driving additional rods at closer spacings will not result in any material reduction in the resistance and any extra rods driven merely

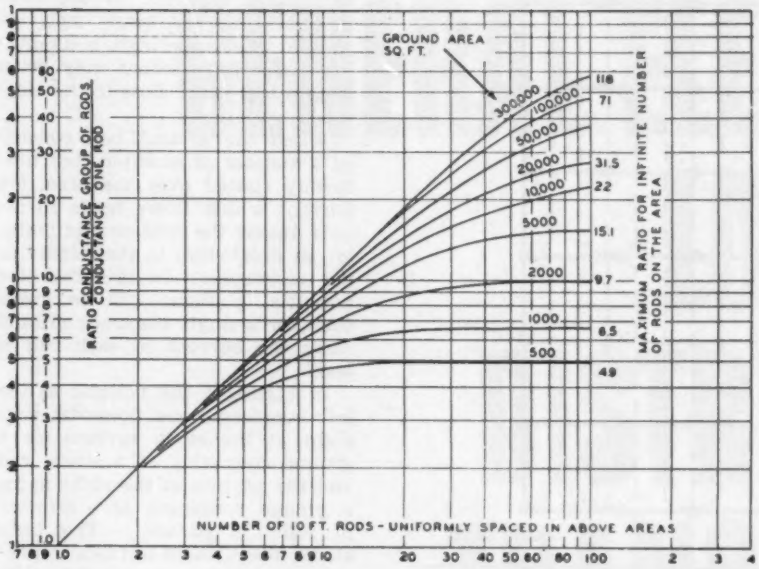


Fig. 6—A chart such as this may be used to determine the approximate number of ground rods required in a given substation area.

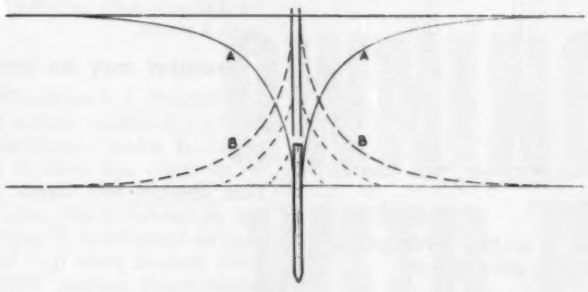


Fig. 7—This shows the variation of resistance and potential drop with distance from a ground electrode, when current flows from a rod.

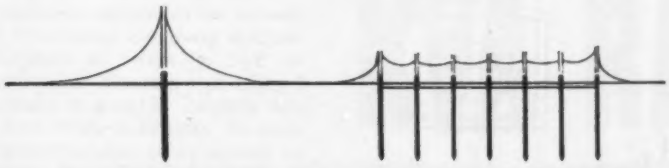


Fig. 8—This represents the potential gradient at the earth's surface from a single ground rod and from a number of rods in parallel.

add to the cost of the installation.

For determining the approximate number of rods required in a given substation area, a chart such as that shown in Figure 6 may be used. This shows the relation between ground area, number of rods, and paralleling effectiveness. To illustrate the use of this chart, suppose that a substation is to be built on a plot having an area of 5,000 square feet. It is proposed to install a ground bed that will have a resistance of five ohms.

A single ten-foot rod driven at the location, for test purposes, showed a resistance of 50 ohms. The conductance of the desired ground connection is, therefore, ten times that of the single test rod. Using the chart, Figure 6, it will be noted that sixteen ten-foot rods uniformly distributed over the 5,000 square-foot area will provide the approximate desired resistance.

Suppose, however, that the resistance of the test rod had measured 100 ohms. In this case, the conductance of the ground bed is 20 times that of the single rod. Referring again to Figure 6, it will be noted that for a 5,000 square-foot area, the maximum ratio of conductance for an infinite number of rods to that of a single rod is only 15.1.

Therefore, regardless of the number of rods that are driven in this area, it is not possible to reduce the resistance to the desired five ohms value. When this condition occurs it may be necessary to increase the overall area of the ground field, use longer rods to reach the better conducting soils, soil treatment, or some other expedient.

Spacing can be computed

With the approximate number of rods known for the desired ground field resistance, the spacing for uniform distribution of the rods over the station area can be readily computed. Usually this spacing will be rather wide because of the practical limitation on the number of rods required to give the desired resistance in the given area. Because of this wide spacing it may be necessary, in some instances, to give consideration to the potentials that may develop at the ground surface during faults.

Where current flows to earth from a rod, a potential gradient is set up in the vicinity of the current-carrying electrode. This is illustrated in Figure 7, which shows the variation of resistance and potential drop with distance from a ground electrode. Curve A shows the distribution of the resistance around the electrode and from this it will be noted that most of the resistance is within the cylinder of earth of a few feet radius immediately surrounding the electrode.

If Curve A is inverted, as shown by Curve B, this represents the voltage gradient around the rod when current is flowing to the earth from the electrode. This indicates that the ground immediately surrounding the electrode is the highest in potential. This may be pictured as a volcano rising out of a level plain. The slope is steepest nearest the crater and it tapers off gradually until it meets the level plain.

Since most of the resistance of the ground is within a few feet from the electrode, the highest potential drop will also occur within

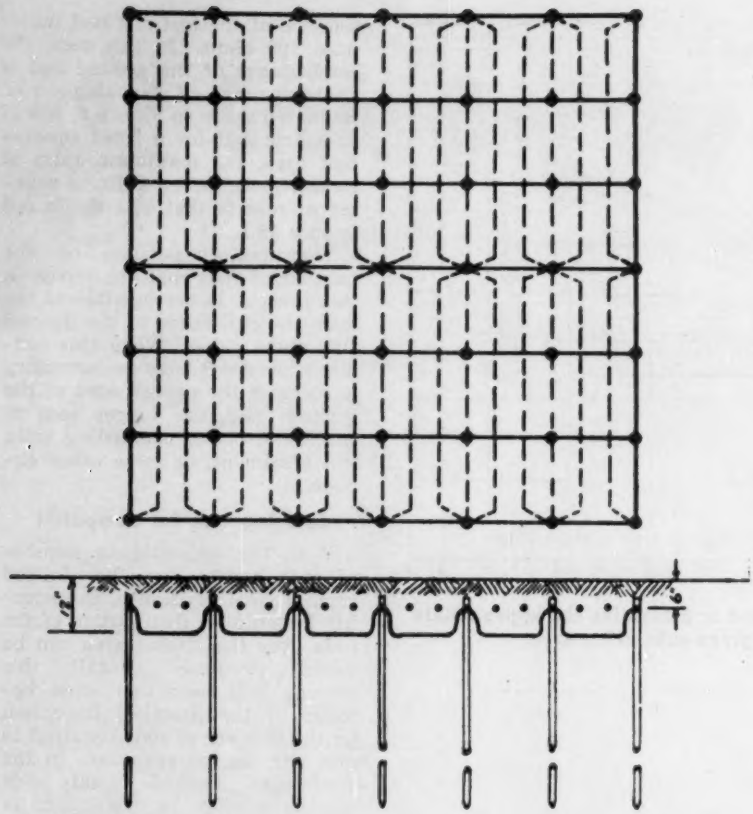


Fig. 9—This drawing shows one type of ground system with grid or counterpoise development superimposed over the ground bed.

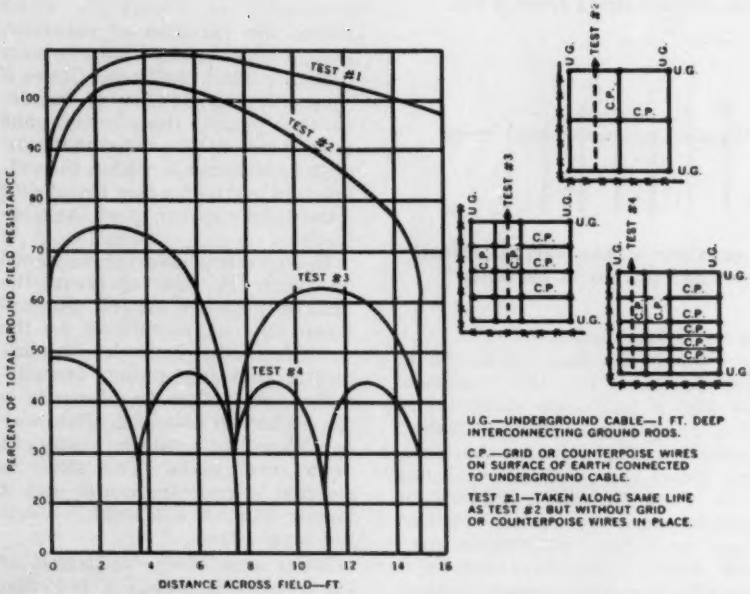

TEST #1
TEST #2
TEST #3
TEST #4
PERCENT OF TOTAL GROUND FIELD RESISTANCE
DISTANCE ACROSS FIELD—FT
U.G.—UNDERGROUND CABLE—1 FT. DEEP INTERCONNECTING GROUND RODS.
C.P.—GRID OR COUNTERPOISE WIRES ON SURFACE OF EARTH CONNECTED TO UNDERGROUND CABLE.
TEST #1—TAKEN ALONG SAME LINE AS TEST #2 BUT WITHOUT GRID OR COUNTERPOISE WIRES IN PLACE.

Fig. 10—This shows the effect of grid or counterpoise wires in reducing potentials over a portion of area inside substation yard.

this same distance. If the fault current is very large and the ground resistance high, a dangerous potential gradient may occur within this space close to the electrode.

When the ground bed consists of a number of multiple rods uniformly spaced over the area, the current which flows tends to divide among the rods approximately in proportion to their individual resistances. In this case the potential gradient will be lower than for a single electrode ground since the current in each rod is less.

In Figure 8, the volcano at the left represents the potential gradient at the earth surface for a ground consisting of a single rod and the portion at the right is for a ground consisting of a number of rods in parallel. The lines above the ground surface represent the relative ground potentials at the corresponding points. Note the very steep gradient around the single electrode which might be dangerous to anyone at or near such a point.

Gradient may be hazardous

Although a considerable reduction in potential gradient may be obtained when a number of rods in multiple are used in a substation ground bed, there may still be instances where the gradient can be hazardous to personnel. A high ground resistance with maximum fault current flowing may result in a voltage at the ground surface that might be fatal to anyone walking in the vicinity.

A method that is sometimes employed to overcome possible high surface gradients consists of a grid or mat of wires or counterpoise buried just beneath the surface of the ground. Figure 9 shows one type of ground system with grid or counterpoise superimposed over the ground bed.

The usual practice in installing these grid wires is to bury them about six inches below the surface of the earth. The grid spacing does not have to be maintained in both directions as small spacings between parallel wires in one direction are practically as effective as the same spacing between wires running parallel in both directions. The outer edge of the ground bed is assumed to be completely enclosed by ground rod interconnection cables.

The size of the grid wires need not be larger than about No. 8 Awg, which has been used on

(Continued on page 133)

GENERAL ELECTRIC LOWERS DISTRIBUTION TRANSFORMER OWNING COSTS WITH PREFERRED KVA RATINGS

GENERAL ELECTRIC

PREFERRED-KVA RATINGS OFFER . . .

5 ways to lower distribution transformer owning costs

Another significant step toward lower distribution transformer investment and operating costs

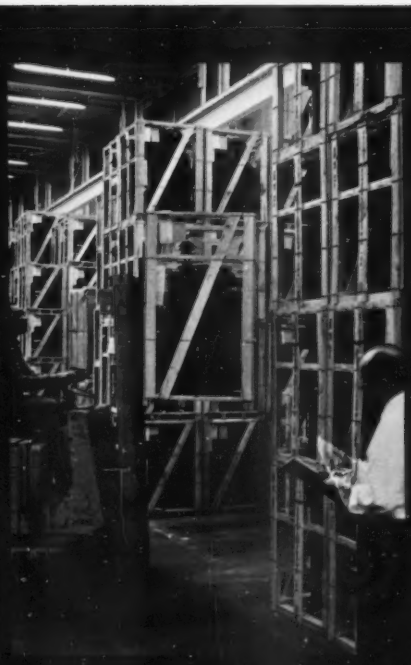
Lower Changeout Cost Use of preferred-kva ratings can lower changeout costs since more load growth can be absorbed. Based on a changeout practice of 150 percent of rating and an annual load growth of six percent, transformer replacement occurs on the average of every 7½ years. With preferred kva ratings, changeout would occur every 12 years, extending the transformer life-on-the-pole 4½ years.

Lower Operating Costs Distribution system operating costs can be lowered by using standard preferred-kva ratings. When preferred-kva ratings are used, the average transformer load is less, lowering total losses. Lower copper losses more than compensate for increased core losses. Also since voltage regulation is related to copper loss, use of General Electric's preferred-kva ratings also means better voltage regulation.

General Electric's preferred-kva distribution transformer program offers you five important ways to lower your total owning costs of distribution transformers. The preferred-kva concept is based on an extensive survey made among representative utilities across the country. The majority of those interviewed preferred standardizing on these 55° ● 65° transformer ratings: 5/5.6, 10/11.2, 25/28, 50/56, 100/112, and 167/187 kva.

By standardizing on these preferred-kva transformer ratings from General Electric, you can own the highest quality transformers at lower total owning cost than ever before possible.

Before you buy another transformer, let your G.E. Sales Engineer show you how you can lower your distribution transformer owning costs with preferred-kva ratings from General Electric.



Lower Inventory Cost You can reduce your transformer inventory costs by standardizing on preferred-kva ratings. For example, if present maximum stock requirements are 20 15-kva units and 35 25-kva units, a total stock of 55 transformers is required. Standardizing solely on the 25-kva rating, total stock could be lowered to 44 units because of the diversity of need.

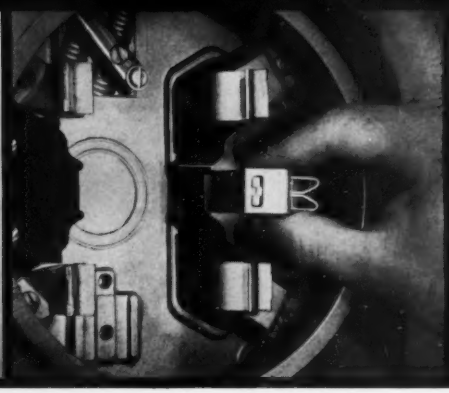
Simplified Procedures Standardizing on preferred-kva distribution transformer ratings lowers the cost of such overhead items as ordering, record keeping and financial procedures. Simplifying these procedures plus simplification of transformer application methods helps lower your total owning cost of General Electric distribution transformers even further.

Lower Initial Price In addition to the other factors which contribute to lower distribution transformer owning costs, General Electric recently lowered the initial price of preferred-kva transformers as much as five percent.

This action was taken to reflect manufacturing cost savings which result when utilities support this program by volume purchases of fewer kva ratings.

Progress Is Our Most Important Product

GENERAL ELECTRIC



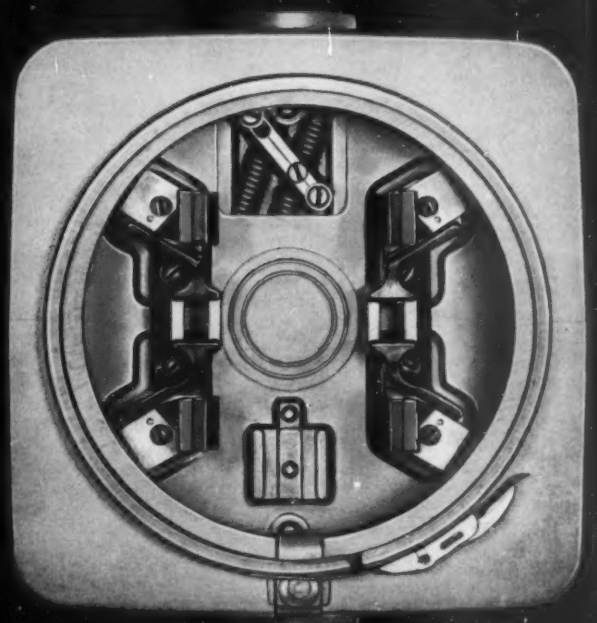
NEW S-2 TERMINAL BLOCK ASSEMBLY—with exclusive one-piece combination jaw and connector strap—permits an unbroken current path from meter blades to line wires for excellent electrical conductivity, low heat rise, for added reliability.

NEW PLUG-IN TERMINAL, another General Electric S-2 exclusive, installs in seconds—without tools, and without removing any part of the meter socket . . . greatly simplifying shop or field conversion to five or six terminal sockets.

EXCLUSIVE SQUARE DIE-CAST ALUMINUM CASE—with baked-on all-weather finish — gives maximum strength, corrosion protection . . . provides full raintight construction . . . unitized hubs. And, modern styling eliminates sharp, hazardous corners.

General Electric Announces . . .

NEW S-2 SQUARE METER SOCKET



General Electric S-2 sockets—for all 100-amp services—offer two **exclusive** new features providing greater reliability, increased versatility.

GREATER RELIABILITY is provided by unique one-piece combination jaw and connector strap—permitting an unbroken current path from meter blade to line or load wires with minimum heat rise.

INCREASED VERSATILITY results from the only true plug-in terminal on the market today . . . installs in seconds—without tools—for easy conversion to five or six terminal socket.

PLUS 6 EXTRA VALUE FEATURES

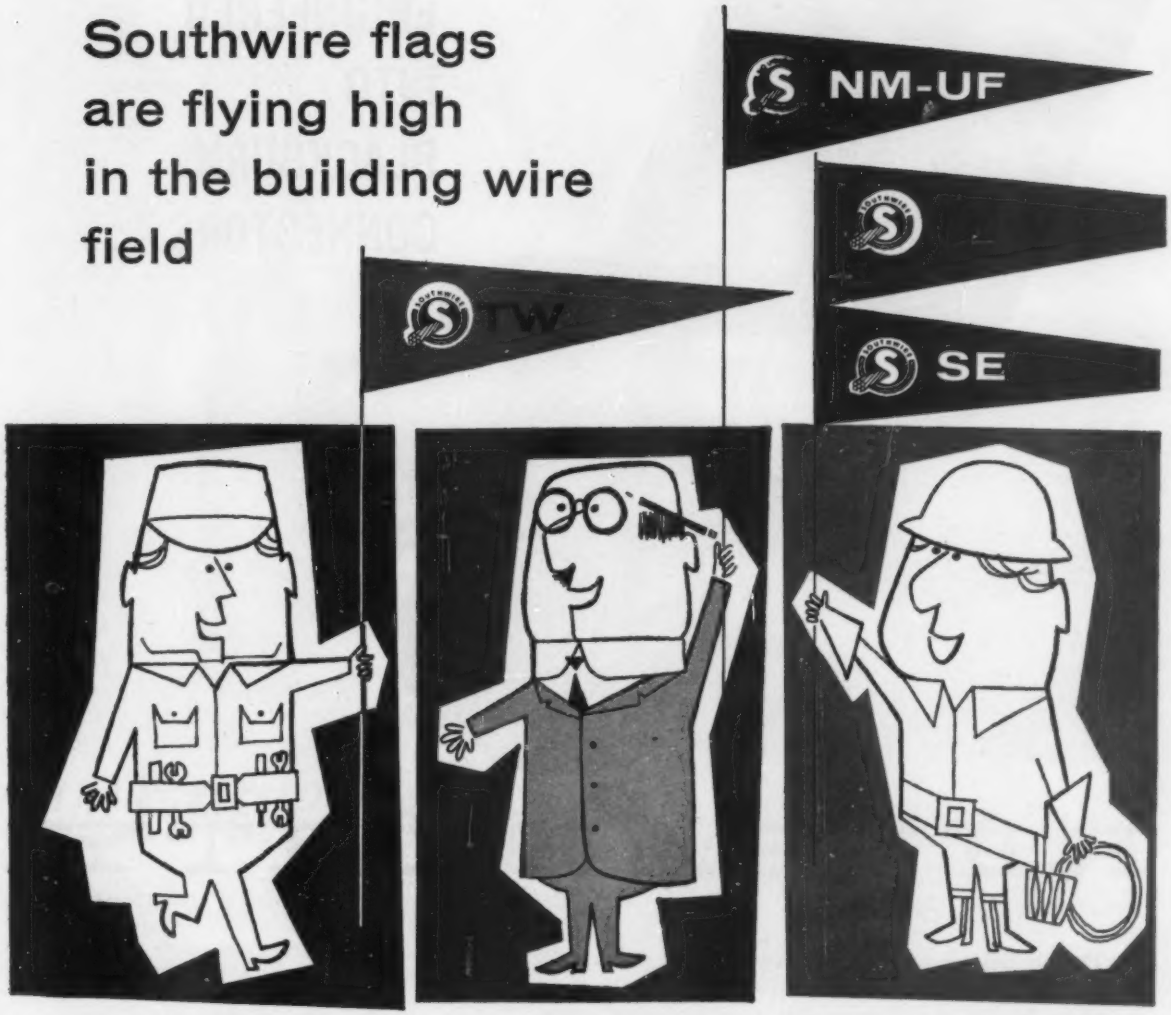
1. **Largest wiring space** of any die-cast socket—144 cubic inches—permits fast, easy wiring.
2. **Die-cast aluminum case**—plus baked-on finish—protects against corrosion and weather.
3. **Lay-in wire connectors** accommodate both aluminum and copper wire.
4. **Positive one-way knockouts** provide a perfect knockout every time . . . eliminate prying or bending.
5. **Choice of neutral connectors**—two channel or single lay-in neutral connector.
6. **Unitized hubs** are cast as part of case . . . no extra charge for second hub at bottom.

NOW AVAILABLE. *Contact your G-E Sales Office or Authorized Distributor for full S-2 information. Or, write General Electric Company, Somersworth, N. H.* 711-01

METER DEPARTMENT

GENERAL ELECTRIC

Southwire flags are flying high in the building wire field



COMPLETE LINE—FULL RANGE OF SIZES—ALL UL APPROVED

(Also available: MACHINE TOOL & APPLIANCE WIRE, FIXTURE WIRE, TELEPHONE WIRE)

In the warehouse or on the job, Southwire building wire is preferred because it is top quality wire that is extra easy to handle. It is manufactured to National Electrical Code specifications and packaged with the folks in mind who sell and use it. Order any of these quality Southwire products and get fast Southwire deliveries — direct by our own trucks.

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP* (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
- Aluminized Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
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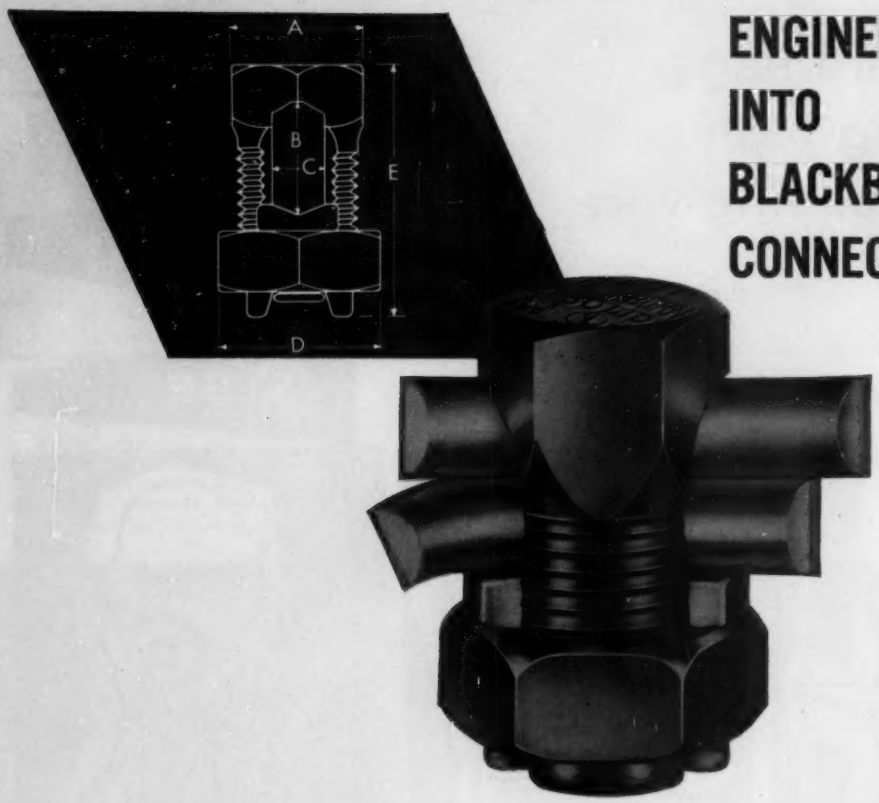
- ALSO FABRICATORS OF COPPER AND ALUMINUM FOR WIRE AND CABLE MANUFACTURERS

Southwire Company

SOUTHWIRE serves the world

Carrollton, Georgia — TErrace 2-6311



ENGINEERED INTO BLACKBURN CONNECTORS...

REUSABILITY!

The big difference in Blackburn connectors starts with the way they are made. The basic material is high strength duronze, a silicon bronze alloy stronger than many structural steels.

High percentage of threads, both bolt and nut, plus proper selection of materials, reduces friction, increases thread efficiency and clamping force—clamping force is maintained on the conductors. Blackburn's strict inspection assures uniform high quality.

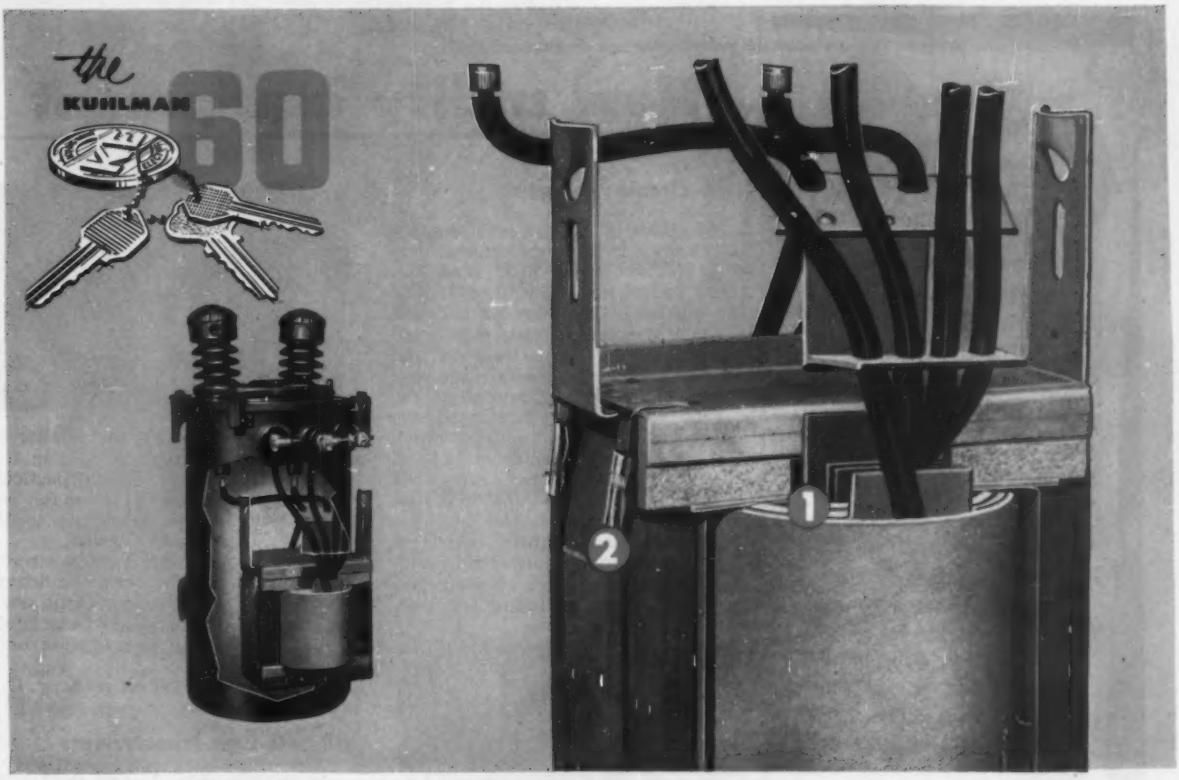
Blackburn connectors give better performance electrically. The greater thread efficiency provides a high clamping force that helps break through oxides on the conductor and improves conductivity. This high initial conductivity is maintained permanently.

Because of the better materials, precision workmanship and careful inspection, Blackburn connectors are reusable . . . over and over. Write for samples.

LIVE BETTER ELECTRICALLY

Jasper BLACKBURN Corporation

1525 Woodson Road • St. Louis 14, Mo.

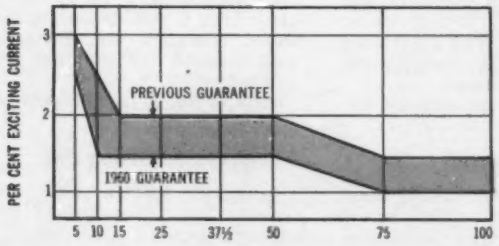


"ALL NEW" Core and Coil Saves Revenue Dollars

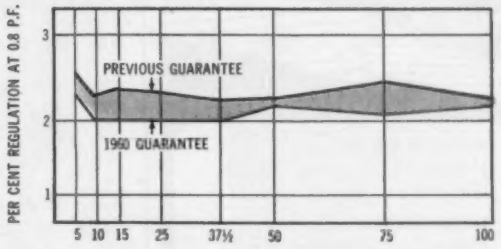
Here are four places to look for new savings in the ALL NEW Kuhlman '60 transformer:

1. *The coil*—mechanically stronger with improved electrical characteristics and an "all new" core that offers more compactness and low copper and core losses. Savings: more transformer for your dollar; less drain per transformer on your system.

2. *The core*—smaller, more efficient with fewer and shorter gaps is designed for minimum local flux concentration and maximum flux flow. Savings: More transformer per pound; more efficiency and operating economy.



3. *Lower guaranteed exciting current*—the result of new Kuhlman '60 efficiency and lower losses—covers all popular ratings as shown above. Savings: Lower exciting current values conserve generating capacity and revenue-producing power.



4. *Better guaranteed regulation*—due to the lower impedance of the new redesigned coil—offers improved regulation in all popular ratings (see above). Savings: The customer gets full power; you get full revenue.

In the face of rising costs, here's one sure way to save revenue dollars. Install ALL NEW Kuhlman '60 transformers. They are more efficient and cost less to operate.

KUHLMAN TRANSFORMERS

KUHLMAN ELECTRIC COMPANY, Birmingham, Mich.

Manufacturers of transformers since 1894

FACTORIES: Bay City, Mich. • Crystal Springs, Miss. • Salinas, Calif.

*Trademark

"Superforms* handle well" ...say CONSTRUCTION and MAINTENANCE ENGINEERS

"Superforms require no tools for regular use . . . they are readily adaptable for hot-line tools . . . they give us uniformity of application and result . . . they *handle well!*"

Construction and Maintenance Engineers . . . the men responsible for *getting things done Fast, Right and at Low Cost* . . . are making more and more use of Fanner Superforms, everywhere!

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FANNER Superformed with a "PROTECTIVE TWIST"

ARMOR RODS... Protect long-span T&D lines at supports

LINEGUARDS... Protect short-span T&D lines at supports

PATCH RODS... Repair damaged conductors

TAP ARMOR... Protects conductor at tapping points

FANNGRIPS... For dead-ending strands and conductors

FANNSPLICES... Join two ends of conductor wire

PLASTIC PRODUCTS... For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

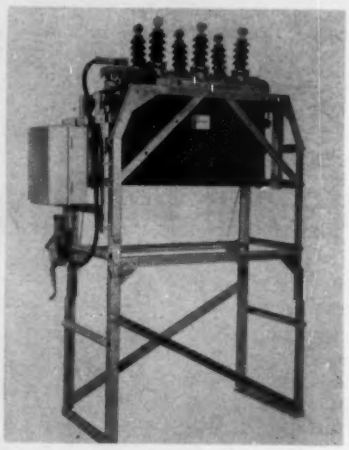
New utility equipment

L-M circuit reclosers

Two new oil circuit reclosers, the first known to feature electronic control, are now offered by Line Material Industries, Milwaukee 1, Wisconsin. Designated types RE and WE, the new reclosers embody all the advantages of previous reclosers and provide increased flexibility and ease of installation, testing, and adjusting.

Type RE reclosers are rated 400 amperes continuous and can interrupt up to 4,000 amperes at 14.4 kv. Type WE reclosers can carry 560 amperes continuously and interrupt up to 8,000 amperes at 14.4 kv.

Both reclosers feature choice of two fast and four retarded time-current curves which can be employed in a sequence consisting of one, two,



three, or four operations to lockout. Minimum-trip settings range from 100 to 1,120 amperes and different reclosing intervals can easily be obtained. Ground-fault tripping can be provided for currents down to 50 amperes.

Types RE and WE reclosers can clear fault currents in 2½ cycles or less over most of their operating ranges to insure good protection of conductors and equipment.

Write in No. U-1101 on card, pg. 17

Lapp insulator slide rule

A new slide rule chart listing complete string flashover values for all EEI-NEMA and fog type suspension insulators is available on request from the Lapp Insulator Co., Inc., Le Roy, N. Y.

Suspension insulators are identified by type, size, and spacing, as well as by catalog number. The flashover values are arranged in such a way that simply selecting an insulator and

adjusting the slide for the number of units per string gives a reading for all flashover values for that particular string. Flashover values for all suspensions, in strings of two to 25 units, are listed on the slide.

The flashover slide rule is attractively printed in two colors on heavy stock and provides a convenient, useful tool for the engineer interested in distribution and transmission line design.

Write in No. U-1102 on card, pg. 17

GE pole-type transformers

Redesigned 500/560-kva pole-type distribution transformers which offer substantial savings in cost and weight are manufactured by General Electric's Distribution Transformer Dept., 1 Plastics Ave., Pittsfield, Mass.

The new transformers represent the latest stage of the department's redesign program for single-phase transformers from 250 through 500 kva.

Compared to the Powermaster line of transformers which General Electric introduced in 1958 in conformance with EEI-NEMA standards, the new line of transformers is smaller in size, lighter in weight, and lower in both losses and price.

The new 500/560 kva units are available in standard voltage ratings through 15 kv and are equipped with the mechanical features and accessories associated with smaller pole-type transformers. These features include type C pole-mounting lugs, internal operation tap changers, and wall-mounted HV bushings (five kv and below).

Write in No. U-1103 on card, pg. 17

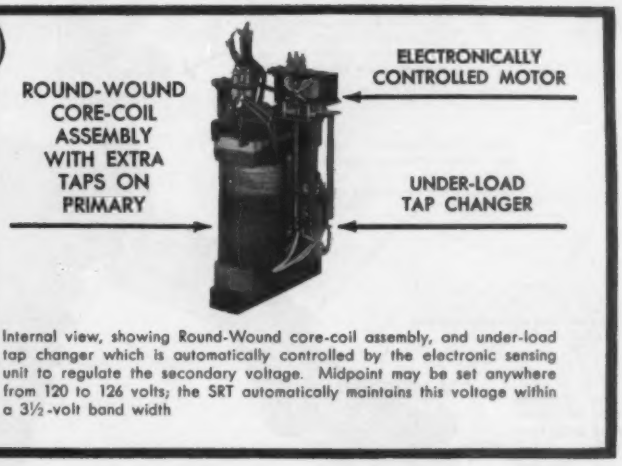
Compression fitting line

Anderson Electric Corp., P. O. Drawer 2151, Birmingham 1, Ala., has introduced a new line of compression products which provide the industry with one of the first standardized designs in compression fittings.

An illustrated brochure is now available from Anderson, describing the compression connectors and new

(Continued on page 86)

SRT simply replaces conventional transformer where you have a regulation problem. It requires no extra pole space, no additional wiring. Note the new electronic unit—mounted externally where it is not affected by oil temperature changes, and is easily accessible for changing midpoint settings if desired.



Internal view, showing Round-Wound core-coil assembly, and under-load tap changer which is automatically controlled by the electronic sensing unit to regulate the secondary voltage. Midpoint may be set anywhere from 120 to 126 volts; the SRT automatically maintains this voltage within a 3½-volt band width

L-M's Electronic SRT®

Now in Full Production For Immediate Delivery

L-M's exclusive Self-Regulating Distribution Transformer fully tested in actual service for two years. Now new electronic control on the SRT® offers greater flexibility in the field, easier accessibility, longer expected life.

The Self-Regulating Transformer, developed by Line Material and put on the market in limited quantities two years ago, has been highly successful. By regulating right at the point of use, the SRT can solve both low-voltage and over-voltage problems and can provide better service for utility customers. Thus it greatly reduces customer complaints caused by voltage variations. Under most conditions, the SRT is the most economical means of voltage correction. In addition, extensive utility tests have proved the SRT reliable and efficient.

How the SRT Operates

The SRT requires no additional pole space, no extra wiring. Instead, the SRT contains, in one tank, a distribution transformer with extra taps on the primary, a regulating mechanism that is volt-sensitive on the secondary, and an automatically operated under-load tap changer on the primary. As secondary load fluctuates, the tap changer switches primary turns in or out to keep secondary voltage within a 3½-volt band width around a predetermined 120 to 126 volt midpoint.

Now With New, Field Tested Electronic Control

The SRT was originally equipped with a hydraulic operating unit that proved extremely dependable and accurate. Further work by L-M research engineers has resulted in an electronic solid state control that thorough field testing shows is not only exceedingly accurate, but also completely flexible. It may be adjusted to any desired mid-point voltage while the transformer is operating without the use of instruments.

Since the electronic unit is external to the tank, its components, therefore, are not affected by high oil temperatures associated with transformer loading. In addition, the total absence of moving parts assures life expectancy comparable to that of the transformer without need for periodic inspection.

Get Complete Details on SRT

Ask your L-M Field Engineer to show you reports from utility companies having extensive experience with the SRT, and details on its operation and application. Or write Line Material Industries, Milwaukee 1, Wisconsin.

YOU BE THE JUDGE OF SRT VALUE

Ask the L-M Field Engineer to present the evidence of value of the cool-running Round-Wound® Transformer, and the great new Electronic control. Then *you be the judge!*

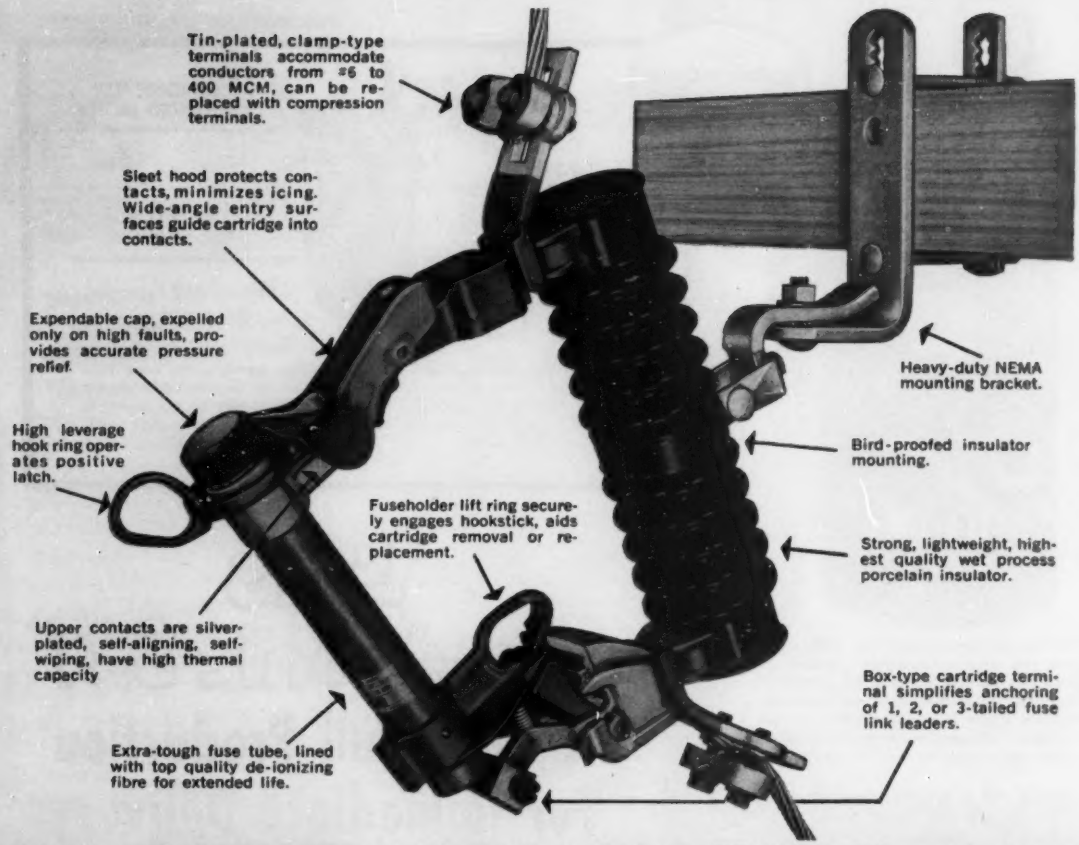
LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

Distribution Transformers

478

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT


Tin-plated, clamp-type terminals accommodate conductors from #6 to 400 MCM, can be replaced with compression terminals.
Sleet hood protects contacts, minimizes icing. Wide-angle entry surfaces guide cartridge into contacts.
Expendable cap, expelled only on high faults, provides accurate pressure relief.
High leverage hook ring operates positive latch.
Upper contacts are silver-plated, self-aligning, self-wiping, have high thermal capacity
Extra-tough fuse tube, lined with top quality de-ionizing fibre for extended life.
Fuseholder lift ring securely engages hookstick, aids cartridge removal or replacement.
Heavy-duty NEMA mounting bracket.
Bird-proofed insulator mounting.
Strong, lightweight, highest quality wet process porcelain insulator.
Box-type cartridge terminal simplifies anchoring of 1, 2, or 3-tailed fuse link leaders.

NEW KEARNEY 200 AMP "HX" CUTOUT

Kearney substation-proved to positively and repeatedly interrupt 12,000 amperes at 7.8 KV . . . 10,000 amperes at 15 KV

- No "blind" spots . . . a highly efficient combination of single end venting and expendable cap double venting insures dependable interruption throughout the entire fault range . . from low current values to maximum rated capacity of the cutout.
- On low and medium faults, expendable cap remains intact . . . tube vents only at bottom. Controlled spring loading and long travel of lower hinge toggle whips fuse cable out of cartridge to insure positive low current interruption.
- Expendable cap is expelled only on high faults. Resultant double end expulsion in line with fuse tube relieves gas pressure, equalizes interruption shock forces and prevents damage to cutout or bracket.
- Switchstick-operated positive latch prevents accidental cartridge dropout due to vibration, impact, or magnetic forces.
- Strong, durable, non-ferrous construction for long life, optimum performance. All current-carrying parts copper alloy. Silver-plated contacts. Stainless steel pins and springs.
- Fuseholders accept all conventional button-type links.
- Kearney "HX" Fuse Cutouts are available on single insulator, NEMA station-post, or centerbolt insulator mountings; also in 100 ampere continuous ratings.

Ask your Kearney Sales Representative for full information or write for "HX" Cutout Bulletin

KEARNEY

for better construction . . . safer maintenance . . . specify KEARNEY products

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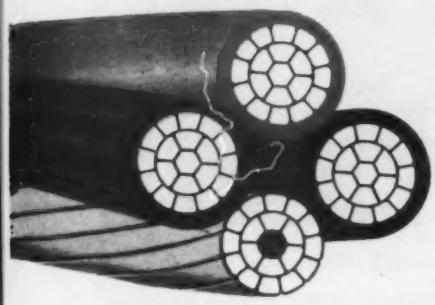
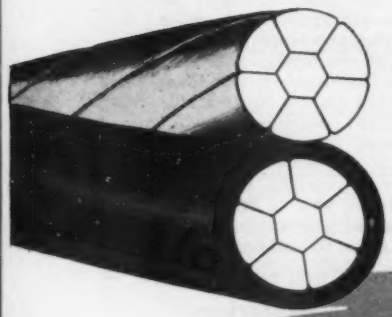
COLOR EVOLUTION

Triplex Secondaries by **SOUTHERN ELECTRICAL** Take on Lasting Color With **HYPALON®***



COLOR-CODED CABLES Insulated With HYPALON® Have These Major Advantages:

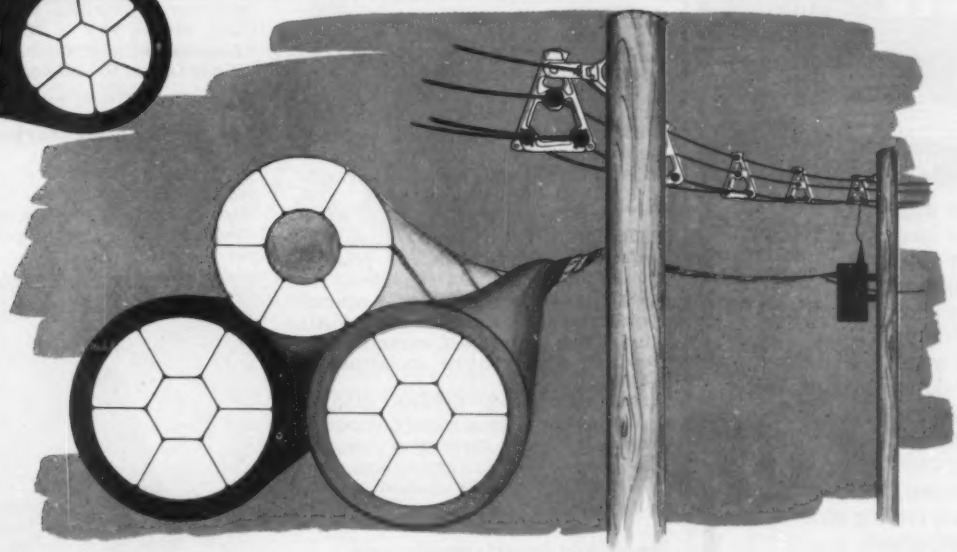
- Positive phase identification, permitting load balancing;
- Available in black, electrical red and electrical grey;
- Outstanding resistance to ozone;
- Excellent resistance to heat, chemicals, flame;
- Improved resistance to compression cutting when used on COMPRESTO®
- HYPALON® can be stripped freely at field temperatures;
- Electrical properties of HYPALON® permit its being rated as a 600-volt class multiplex cable.



*Synthetic rubber covering with properties that exceed Two-Coat coverings for service drop cables.

Hypalon® is a registered trademark of E. I. du Pont de Nemours & Co., Inc.

Compresto® is a registered trademark of Southern Electrical Company.



OLIN CONDUCTORS

METALS DIVISION **Olin** Electrical Conductor Sales • Chattanooga, Tennessee

*Trademark

"Superforms* are packaged for storeroom convenience" ...SUPERVISOR OF STORES

"The Fanner people understand our store-room problems.

"Their Superformed products are packaged right . . . well identified . . . easy to handle and store . . . don't get mixed up . . . are well catalogued . . . and, they arrive on time."

The thousands of items that must be stocked, and *readily available*, present a tough problem for Store Room Supervisors. Fanner recognizes this, and *cooperates!*

A-1502A

FANNER
Superformed
with a
"PROTECTIVE TWIST"

ARMOR RODS...
Protect long-span T&D lines at supports

LINEGUARDS...
Protect short-span T&D lines at supports

PATCH RODS...
Repair damaged conductors

TAP ARMOR...
Protects conductor at tapping points

FANNGRIPS...
For dead-ending strands and conductors

FANNSPLICES...
Join two ends of conductor wire

PLASTIC PRODUCTS...
For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

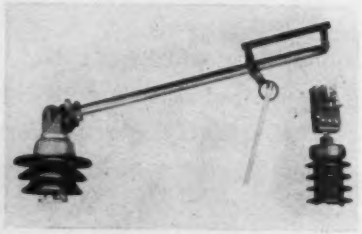
developments and improvements included. Several products covered are completely new to the market.

Anderson can now recommend use of specific products for common distribution line applications. Features of the new compression fitting line include standardized design, allowing use of other manufacturers' tools and dies; current equalizing design, including thicker connector barrier walls to prevent overloads; greater ductility with improved aluminum alloy; and new "Tensiongrip" sealant for high-tension holding power and oxide-free connecting points. Anderson compression connectors are also color-coded.

Write in No. U-1104 on card, pg. 17

Breaker disconnect switch

Type PEB hook stick switches have been added to the air switch line of Line Material Industries, 700 W. Michigan St., Milwaukee 1, Wis. These switches are available for outdoor substation applications in the horizontal mounting position between station bus support and breaker bushing. With a momentary rating of 20,000 and 40,000 amperes, the switches have a continuous current rating of 600 and 1,200 amperes at voltages of 115, 138, and 161 kv.



The PEB switches meet all AIEE and NEMA specifications. They feature ease of operation and positive action under adverse conditions for disconnecting applications. A special feature of this switch line is the adjustable front contact mounting allowing for variations in structure elevations.

Other features include positive latch and pry-out assembly, counterbalance spring, permanent lubrication, and sealed current interchange.

Write in No. U-1105 on card, pg. 17

Insulated transformer cover

To protect against outages caused by birds, squirrels, and other wildlife making contact between the transformer cover and bushing terminal, a fully insulated cover is now being introduced as a standard item on distribution transformers made by the Pennsylvania Transformer Div., McGraw-Edison Co., Box 330, Canonsburg, Pa. Units equipped with the new cover will include all pole-type transformers above five kv in the company's "Pole Star" distribution line.

The new insulated cover, which is finished by means of a special application of polyvinyl chloride, eliminates the need for bushing caps and other special devices to prevent animal-caused outages. The sky-blue coloring of the finish facilitates identification in storage and on poles.

The cover possesses outstanding resistance to corrosion, and the same finish as that used on the cover will be provided on the entire transformer at slight additional cost. Thus, transformer users with installations in highly corrosive areas, such as seashores or certain industrial sections, will be able to take advantage of this added protection.

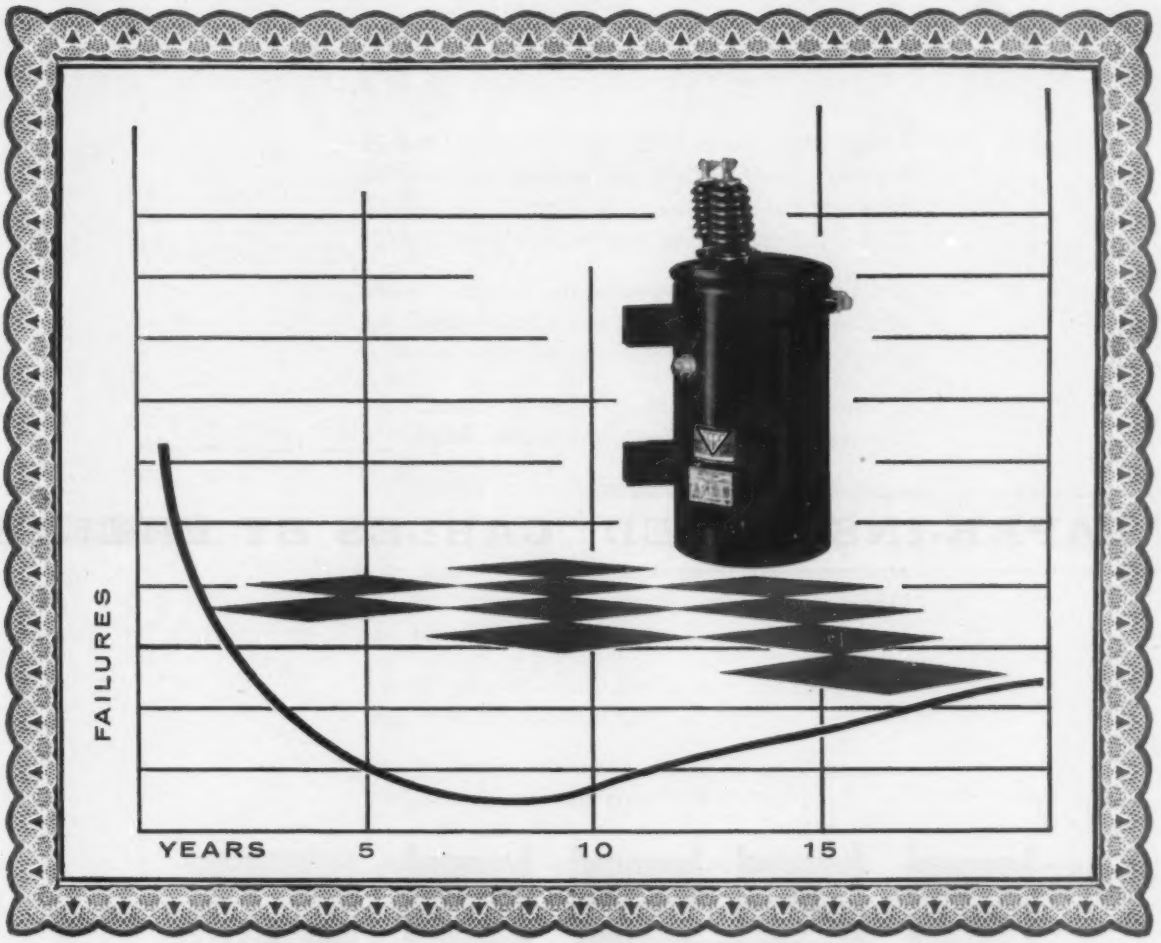
Write in No. U-1106 on card, pg. 17

Pacific Float line markers

Devised to warn low flying aircraft against collision with transmission line crossings, a new hollow cone marker of light plastic is being introduced to the power industry by Pacific Float Co., P. O. Box 78, Dillard, Ore.

Suspended at strategic points from transmission lines crossing waterways or canyons, the bell-shaped warning markers are kept in constant motion by currents of air, a

(Continued on page 90)



GUARANTEED

for 5 years — further proof of the exceptional quality built into every RT&E Transformer to save you money. The wisdom of this guarantee is borne out by the graph above. This typical mortality curve was developed from actual failure rates of one leading utility and covers all makes of transformers. It shows clearly that most transformer failures due to workmanship and materials occur during the first 5 years of use, the critical period covered by the RT&E guarantee.

In addition to this 5 year guarantee against defective materials and workmanship, RT&E also guarantees all fully protected transformers unconditionally for one full year.

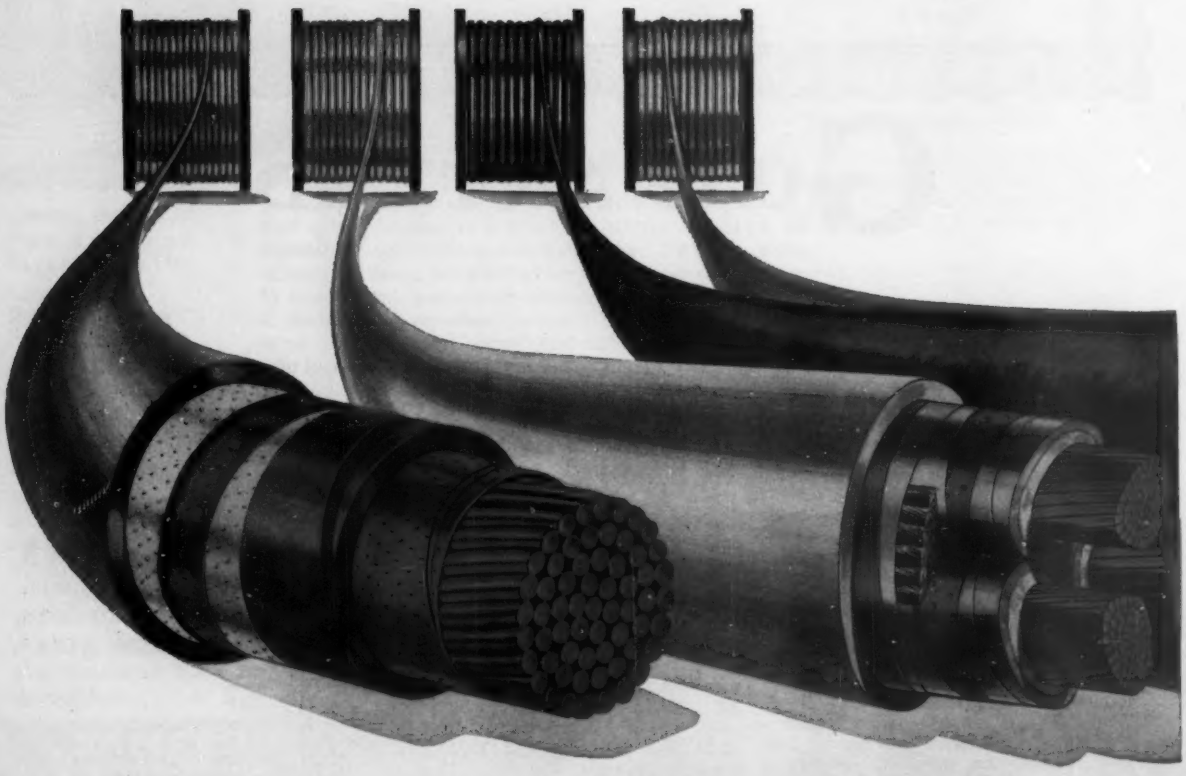
RT&E CORPORATION

WAUKESHA, WISCONSIN
PORTLAND, OREGON
ARLINGTON, TEXAS

EE

FOR THE MOST EFFICIENT
POWER DISTRIBUTION . . . SPECIFY

PAPER-INSULATED CABLES BY PHELPS



Single conductor, 1 KV and up

Three-conductor, 1 KV and up

DODGE!

Phelps Dodge paper-insulated power cables have a *demonstrated record* of long life in a great variety of designs for all types of applications—underground duct, direct burial, submarine and aerial.

Paper-insulated cables have these important inherent characteristics that improve operating performance and lengthen service life:

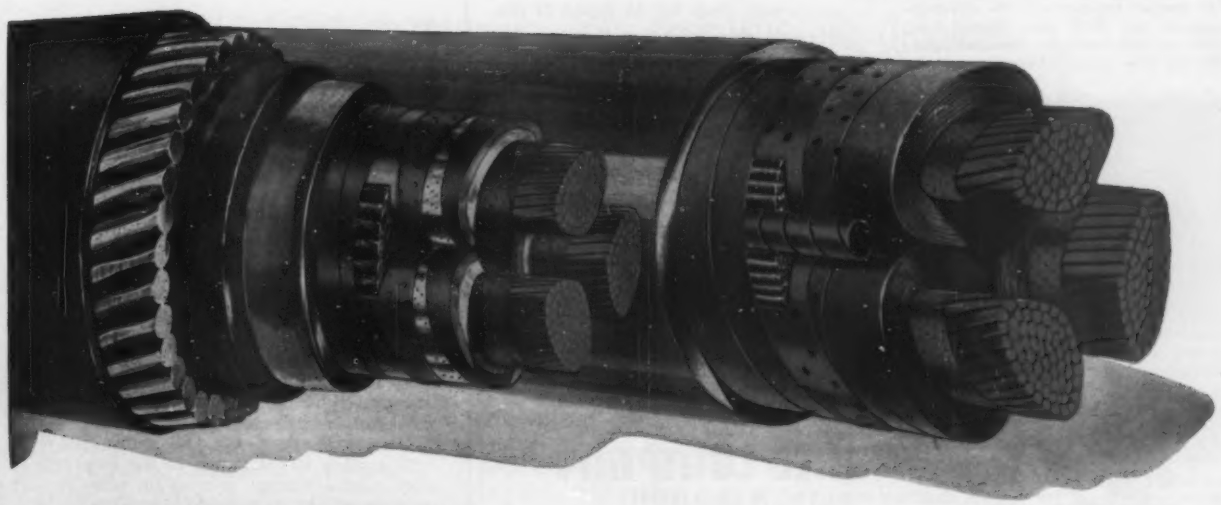
- Extra high 60-cycle and impulse strength to withstand switching and lightning surges.
- Ability to handle large blocks of power in single cables of minimum dimensions.
- Positive protection against all contaminations, due to being hermetically sealed in an extruded metallic sheath.

Paper-insulated cables can be supplied with either lead or aluminum sheaths.

Phelps Dodge offers the widest range of high voltage cables to the electrical industry.

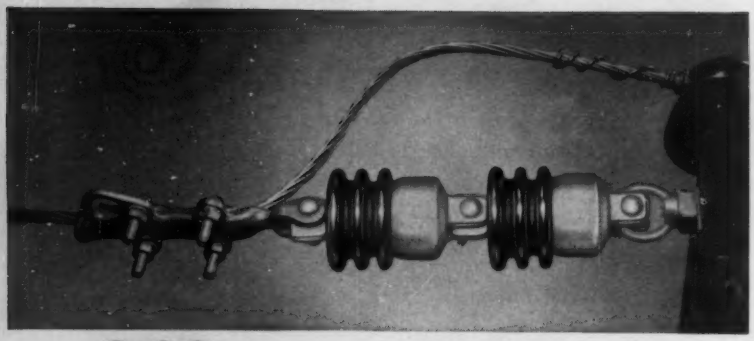
PHELPS DODGE COPPER PRODUCTS
CORPORATION

300 PARK AVENUE, NEW YORK 22, NEW YORK



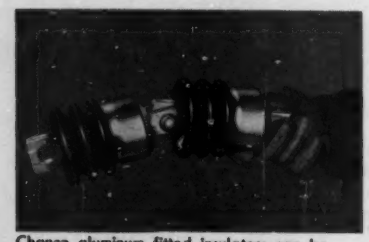
Submarine, 1 KV and up

Low-Pressure gas-filled, 8 KV and up



New Chance Distribution Deadend Insulators have Corrosion Resistant Aluminum Fittings

500 hour salt fog tests had little effect on aluminum cap (left), while ferrous cap (right) is badly corroded and damaged after the same amount of exposure.



Chance aluminum fitted insulators can be handled easily without breaking because the square tongue keeps porcelain apart.

Here's the new look in distribution deadend insulators . . . Chance Insulators with aluminum caps and studs. New in design. News because they're the first insulators with corrosion-resistant all-aluminum hardware that makes them as much as 30% lighter than standard insulators and ideal for all types of distribution deadend installations. Because they are lighter, they're easier to handle and install . . . simplify the lineman's job when he's hanging two or more insulators. And, because the aluminum hardware is highly resistant to all weather and industrial corrosion factors, they have a longer service life. Your Chance Man has the full story. Get it. Then, use these new Chance Insulators for better distribution line construction.

A.B.C. Industries

R. B. CHANCE COMPANY
CENTRALIA, MISSOURI
(A. B. Chance Company of Canada, Ltd., Toronto) C160-32

distinct improvement over the commonly used spherical markers. Color impregnated in international orange, in accordance with international air safety codes, the conical devices are fabricated of fiberglass reinforced plastic and weight as little as four pounds apiece.

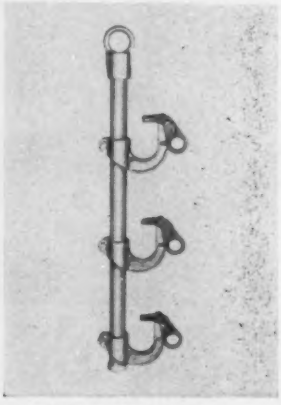
Twenty inches high and 20 inches in diameter at the base, the markers are readily suspended from crossing wires by means of split bolt-type hangers.

Originally designed at the request of Douglas Electric Cooperative, Inc., Douglas County, Ore., the initial installation of the air safety high line markers was at that utility's Ten-Mile Lake crossing where they have been declared markedly successful. Cost of the markers is from $12 to $20 per unit, depending upon quantity.

Write in No. U-1107 on card, pg. 17

Temporary secondary rack

A. B. Chance Co., 210 N. Allen St., Centralia, Mo., has designed a temporary secondary rack which holds secondary wires away from the pole while hot work is being done on the primary. The rack also



can be used to hold hot conductors out of the way for pole removal or installation plus many other jobs where a conductor must be held out of the way. The rack is suspended from the top of the pole by the use of rope.

Write in No. U-1108 on card, pg. 17

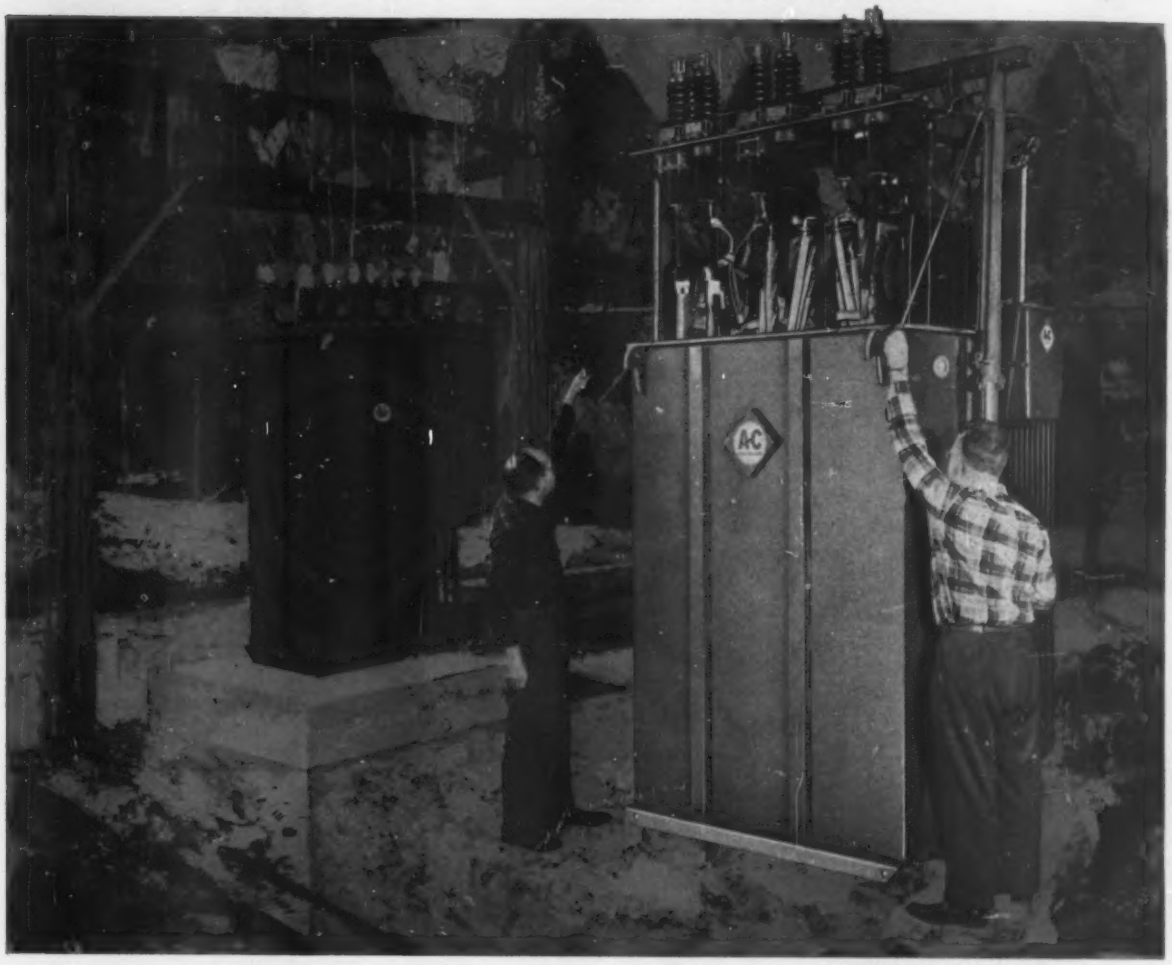
Synchro-verifier relay

New synchro-verifier relay (type CVE) used to verify the condition of synchronism existing between two system voltages is available from the Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa. The CVE relay is adjustable to provide a contact closing zone between plus and minus 20- and 60-degree phase angle difference between the two sources.

This relay is connected to the two single-phase voltage sources on either side of an open circuit breaker. When these two sources are in syn-

ALLIS-CHALMERS

ORIGINATORS OF 5/8% STEP REGULATORS



SFR Feeder Voltage Regulator

Only exclusive unit construction delivers

extra regulator values you can see

Why is unit construction so important to regulator users? Simply because this design is *basic* to these many other extra-value A-C features *you can see*...advantages you can't find on any ordinary regulator!

You'll see continuous leads passing directly from the coils to the double-bolt terminals on the dial switch.

You'll see 78 fewer bolted connections only unit construction can offer. No leads to disconnect, no terminals to remove when you untank.

You'll see better workmanship, since all connections are securely made and double-checked *before* unit is tanked!

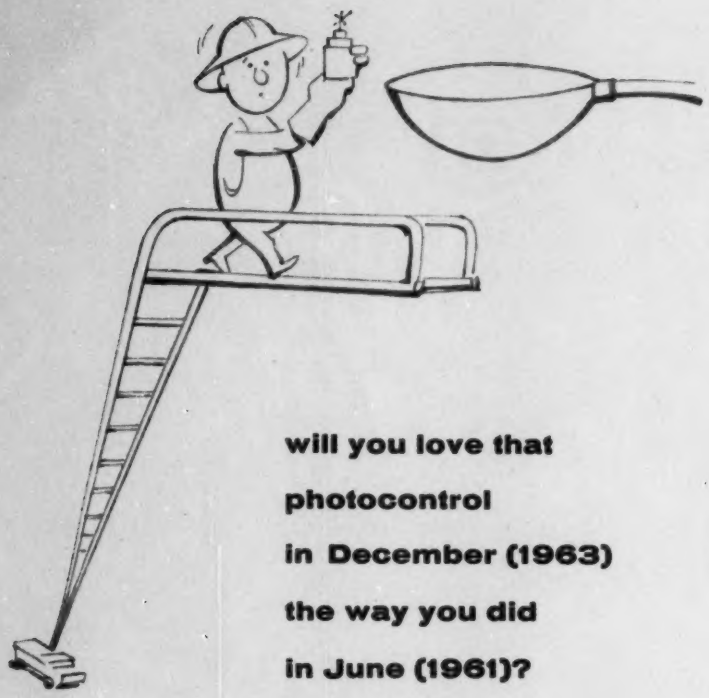
You'll see how much easier inspections can be. To untank, remove cover bolts and control compartment retaining nuts. Then lift entire assembly from the tank . . . there's no need to remove oil.

Your nearby A-C office has the facts on single and three-phase sizes from 2,400 to 69,000 volts . . . in ratings up to 2,500 kva. Or write **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin.

A-1379

Caliband is an Allis-Chalmers trademark.

CALIBAND control — At the twist of the control knob, you can set or test voltage level and band width without changing voltage or interrupting regulated service.



will you love that photocontrol in December (1963) the way you did in June (1961)?

Getting stung with 30,000 "inexpensive" photocontrols that all start failing off three years after installation is no joke, as you can imagine. What kind of *people* make and sell the controls you plan to buy — and are you getting the straight story from them? The Fisher-Pierce Co., 59 Pearl St., So. Braintree 85, Mass.

FP

FISHER PIERCE

Electrical and Electronic Equipment for Industry, Utilities and the Home

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

chronism and equal in voltage, the relay contacts close to permit closing the circuit breaker to connect the sources together.

Features of the new CVE relay include lower volt-ampere burden, smaller case size and minimum magnetic coupling between the two voltage supply sources, and independent electrical circuits for the two sources.

In addition, the CVE relay eliminates the need for the companion-type CV relay previously used with the CI synchro-verifier.

Write in No. U-1109 on card, pg. 17

Inductive pick-up assembly

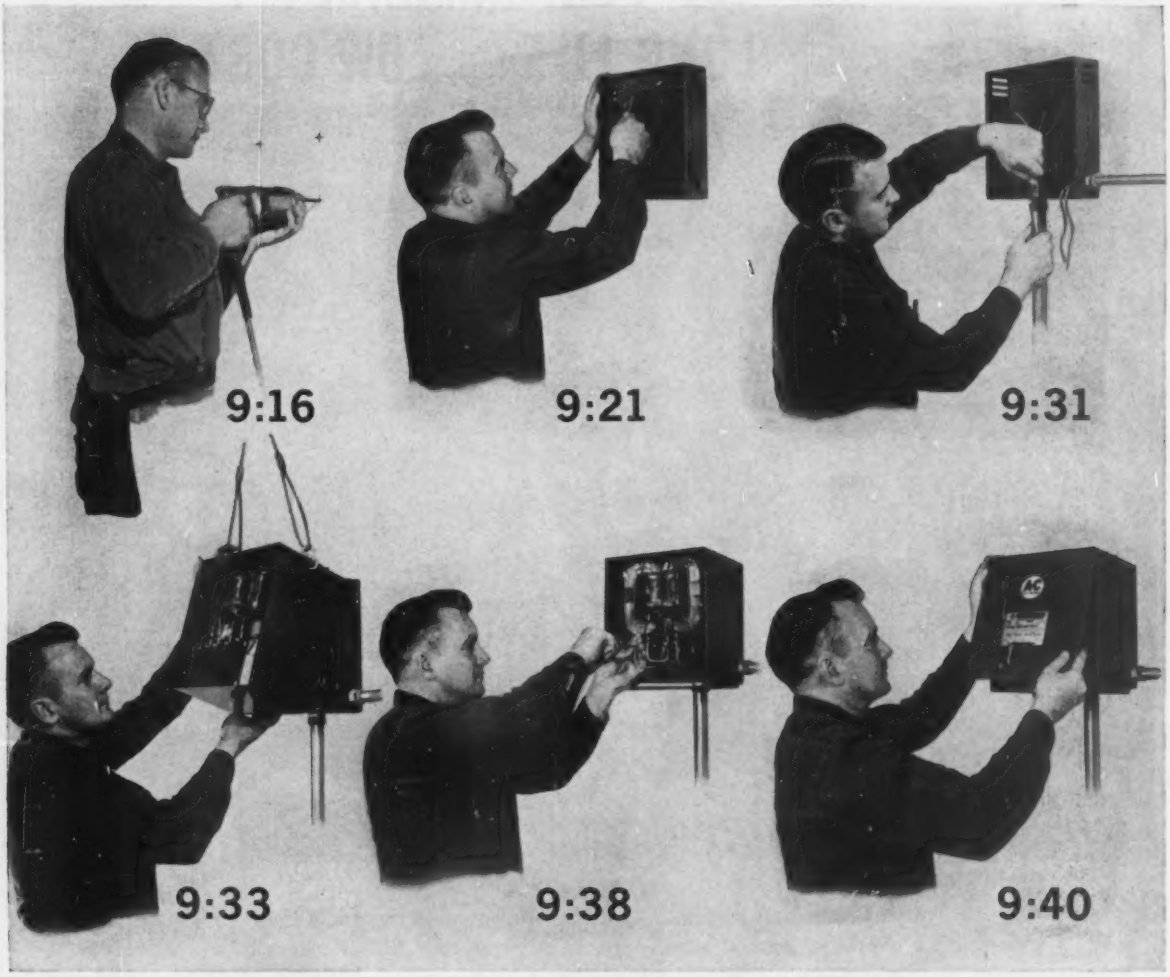
A new pick-up assembly comprised of an induction coil enclosed in a post-type insulator is designed so that a conductor resting on the top of the insulator causes a proportional voltage to be induced in the coil. The assembly, made by the Fisher-Pierce Co., 42 Pearl St., S. Braintree 85, Mass., can be used for capacitor

switching based on phase angle, current, or both; load limit tripping, checking, or warning; power direction sensing; and line current measurement.

Among the major advantages of the pick-up assembly are its low initial cost, economy, and safety of simple

ALLIS-CHALMERS

A-1360



9:16 — 16 minutes to drill 4 holes in concrete wall and add lead inserts to receive screws. 9:21 — 5 minutes to mount back panel to wall. 9:31 — 10 minutes to punch out knockouts and attach conduit. 9:33 — 2 minutes to put center case section in place and tighten side screws. 9:38 — 5 minutes to pull cables and connect to terminals. 9:40 — 2 minutes to fasten front panel to center section with side screws. Installing time: 40 minutes instead of the usual hour and a half!

35% smaller, lighter, new whisper-quiet dry-type transformers

cut installing time in half!

New A-C design eliminates common installation problems! Unique 3-piece case makes handling, wiring go like clockwork. 35% smaller and lighter, you can install them in 40 minutes instead of the usual 90 minutes.

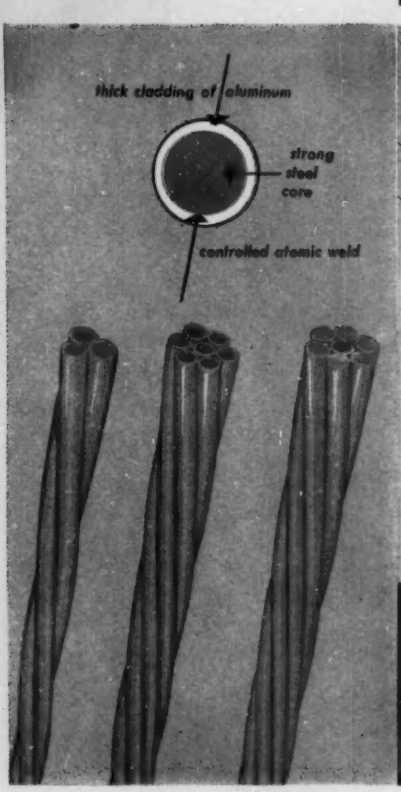
And they're whisper-quiet. Every known factor in subduing noise has been incorporated . . . core impregnation, core and coil assembly suspension isolated from case . . . plus use of nonresonate casing. Exclusive *Curvacore* construction lowers exciting current, core losses.

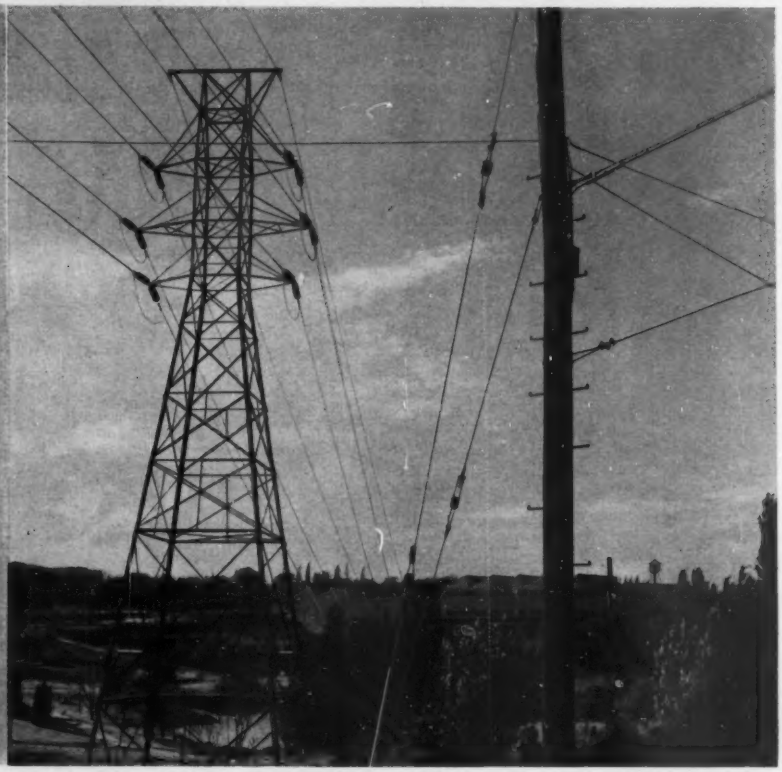
This new 600-volt class indoor dry-type transformer line is available in sizes 3 to 50 kva . . . for on-the-site load center applications where critical voltage must be maintained.

See your nearby A-C office for details or contact **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* Curvacore is an Allis-Chalmers trademark.

The Alumoweld technique of welding aluminum to steel

means TOP PERFORMANCE... LONG LIFE... LOW COST





• You cut costs and assure top performance of your overhead lines when you use Alumoweld for overhead ground wire, guys, messengers, and ACSR core wire • You'll have no maintenance worries because a thick cladding of pure aluminum permanently protects Alumoweld's high-strength steel core from corrosion. In fact, Alumoweld has the same corrosion resistance as solid aluminum wire—and 33% of the electrical conductivity. Compared to steel, Alumoweld has three times the conductivity . . . is 18% lighter . . . just as strong . . . and will last far longer.

For overhead ground wire, Alumoweld is tops. The high strength-to-weight ratio permits stringing with smaller sags, thus increasing the mid-span clearance. Its excellent conductivity quickly discharges transient currents to ground—reduces service interruptions.

For guys and messengers, Alumoweld gives long, trouble-free life because it cannot rust. And it's strong and easy to install.

For core wire in ACSR Conductors, Alumoweld eliminates the danger of electrolytic action because it is compatible with solid aluminum wires. It coordinates the life of the strength members with that of the conductor members.

Get all the facts on this low-cost wire and strand by writing today for bulletin E.D. 3000.

ALUMOWELD

COPPERWELD STEEL COMPANY

installation without line break-in, dead-ending, or service interruptions. The conductor is simply lashed to the groove in the insulator.

The Model S467-1 pick-up assembly provides an output voltage directly proportional to the conductor current—½ volt output for 30 amperes of conductor current, one volt for 60 amperes, etc. This ratio is linear with conductor currents up to 5,000 amperes. The voltage output of the pick-up has a fixed phase relationship with the conductor voltage.

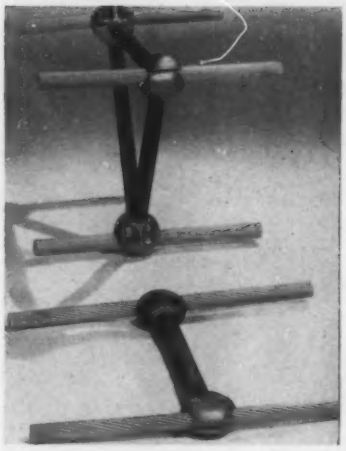
Write in No. U-1110 on card, pg. 17

Bundled conductor spacer

"Hamburger bun" is the aptly descriptive name given to the new spacer for bundled transmission conductors made by the Aluminum Company of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa. Its nickname arises from the appearance of the two oval clamps at either end of the spacer's helical spring body.

Design of the new spacer provides column strength to resist short circuit forces, and great flexibility in other directions to permit normal conductor movement. It incorporates a stainless steel spring, separating cast aluminum clamps.

A variant design, responding to current utility industry interest in three - conductor bundles, has been

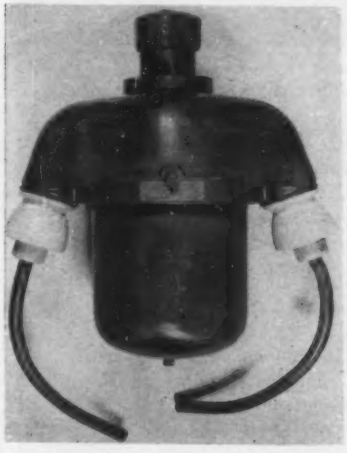


produced by Alcoa. It is a "tri-spacer," using the same type of helical spring component, with spherical clamps.

Write in No. U-1111 on card, pg. 17

General Electric oil cutouts

Two new oil cutouts, with applications for load switching and overcurrent protection, are available from the General Electric Co., Lightning



Arrester and Cutout Section, 1 Plastics Ave., Pittsfield, Mass.

A new 15-kv oil cutout, rated 200 amperes, has a 7,000-ampere interrupting capability. The 15-kv cutout is less expensive, lighter, and smaller than any other oil cutout of a similar rating on the market.

A new 7.8-kv cutout, rated 200 amperes, has a 5,000-ampere interrupting capability. Replacing a lower-rated 7.8-kv cutout, the new cutout incorporates improved components and thus is unchanged in exterior dimensions.

In addition to standard metal-enclosed oil cutouts, special assemblies are available to meet specific requirements. Gang-operated mechanisms provide for simultaneous switching for single or three-phase circuits.

Oil cutouts provide fault current interrupting and load switching in hazardous locations, or where severe atmospheric conditions are a factor.

Write in No. U-1112 on card, pg. 17

Magnetic flotation for meters

Sangamo Electric Co., Springfield, Ill., has introduced true magnetic flotation in two- and three-stator types P20 and P30 polyphase watthour meters. The magnetic flotation system replaces the ball and jewel bearing used in the superseded types P2 and P3 meters. This marks another step in expanding the newly developed magnetic flotation system, which was recently introduced in the J3 single-phase watthour meter, into all types of Sangamo alternating current watthour meters.

The floating system for polyphase meters is very similar to that of the J3. It consists of two bonded cylindrical Alnico magnets located below the disk. The two magnets are positioned so that their opposing magnetic fields support the disk. The self-cleaning gap between the magnets is approximately 1/20-inch wide. Graphite rings and Cobenium pivots guide the disk. Delrin thrust plates, located in each end of the disk spindle, plus adjustable pivots provide positive control of disk position and endshake.

The new flotation system, plus the proven slow speed and high torque characteristics of Sangamo polyphase meters, will further improve their sustained accuracy.

Write in No. U-1113 on card, pg. 17

Pengo super strong auger

A new AA series 48- by 54-inch Pengo super strong earth auger has been developed by Petersen Engineering Co., Inc., 460 Kifer Rd., Santa Clara, Calif., for use on the most powerful earth boring machines in existence.

The new super strong Pengo Auger is available in a full range of sizes in diameters of 24 to 48 inches in 54-inch lengths. These same sizes plus

PRECISION "MULTIPLEX"— ONLY $12.70

Your volume orders for nearly 400,000 fail-proof Precision controls have cut our costs. You save with a price that puts Precision on every pole. The new Multiplex is all Precision but costs less than untried controls.

Guaranteed — backed by more field-service than high priced controls.

Failproof — embodies the original Precision 2-component circuit, field proven on nearly 400,000 installations.

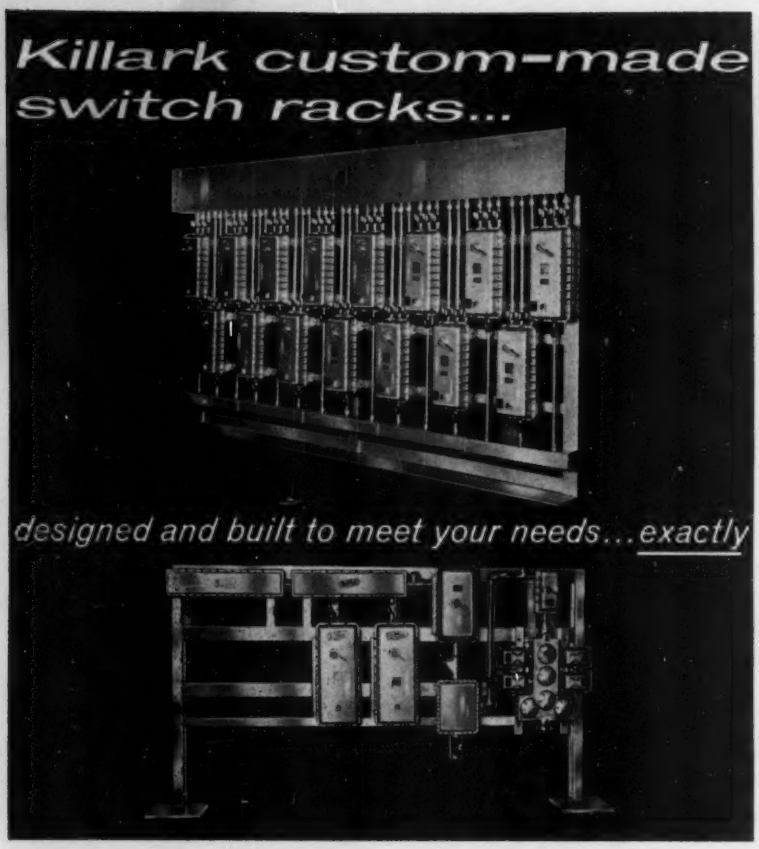
Convenient — smallest, simplest quality control made; fits all NEMA heads.

Write or wire for quantity discounts on $12.70 Multiplex Controls - today.

pmc **PRECISION MULTIPLE CONTROLS**

Pioneers in Automated Lighting Control

233 Chestnut Ridgewood, N. J., U. S. A.



Your worries are over from the moment you choose Killark custom-made switch racks because Killark provides a complete service — design to assembly. First, Killark prepares and submits a preliminary blueprint of the entire unit. drawn to your specifications. After approval, the switch rack is assembled, wired, and sealed *at the factory* by Killark workers with experience and equipment to do the job right. You receive a switch rack ready to install

The two racks shown are examples of the type of custom-made units Killark can provide. Each has been made to meet the users exact specifications, and is completely pre-wired and pre-sealed. Killark's rust-proof, non-sparking *aluminum* enclosures have been used throughout the assemblies to give added years of trouble-free performance.

You get these extras when you order Killark custom-made racks:

Services of expert Killark engineers • One supplier for all components • Dependable Killark aluminum enclosures • Fast delivery • Easy installation.

Racks for outdoor or indoor, hazardous or non-hazardous locations. Write for complete literature.

Killark
ELECTRIC MANUFACTURING CO.
Vandeventer and Easton Aves. • St. Louis 13, Mo.
Sales Representatives and Warehouse Stocks in Principal Cities

6021

Killark Supplies Everything But the Current!

a full range of sizes from 54 to 96 inches are available in the twin helix type. All sizes use the same standard Pengo pilot bit and the new extra strong #20A70 reversible forged Pengo wisdom tooth.

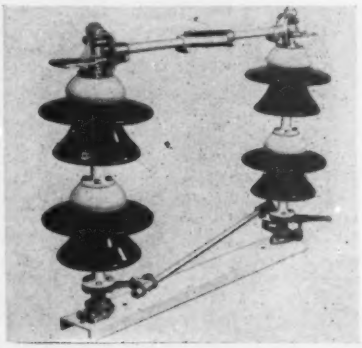
The new auger is designed for boring in coral, basalt, and other materials too severe for the types of Pengo augers and teeth in general use.

Write in No. U-1114 on card, pg. 17

Braidless side break switch

A new braidless, center, side break switch is now being supplied by Southern States Equipment Corp., Hampton, Ga.

Designated the Type GG, the new switch is available in voltage ratings from 34.5 kv through 161 kv and in



continuous current ratings of 600 and 1,200 amperes.

The new switch features a unique swivel assembly, providing low resistance current transfer points, adequate capacity for short circuit current, and freedom from corrosion and contamination.

Both insulator stacks of the GG rotate for switch operation. It is exceptionally easy to operate and has good ice breaking characteristics.

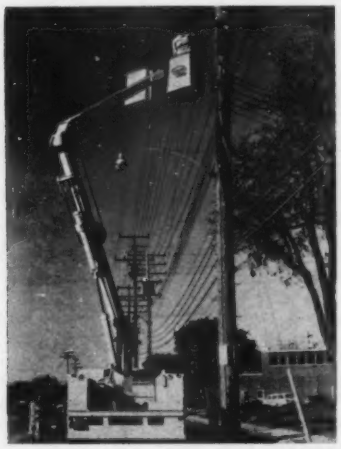
Write in No. U-1115 on card, pg. 17

Duracor plastic insert

A significant new safety factor for the men who man aerial elbows used in electrical construction and line maintenance work is now being introduced by the Holan Corp., of Cleveland, Ohio. Holan is now offering their product with a Duracor reinforced plastic structural member insert in the upper arm for the ultimate in insulation. Duracor is a product of the Ceilcote Co., 4832 Ridge Rd., Cleveland 9, Ohio.

Working up to 55 feet in the air, linemen in direct contact with high voltage wires are insulated from the ground by the Duracor reinforced plastic insert. Fabricated with flexural strength of 38,000 psi, the lightweight Duracor insert also serves as an integral component of the elbow structure.

In recent laboratory dielectric tests, the Duracor insert successfully withstood a jolt of 100,000 volts for one minute. Strength tests proved the



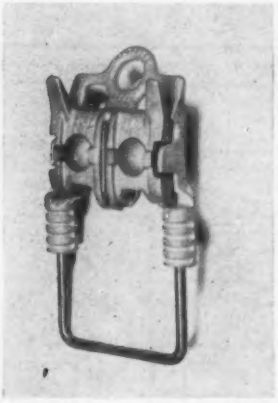
Duracor section has a safety factor of five to one. In addition, a standard AIEE 50,000 volt/ten-second spray test was conducted with highly satisfactory results.

Write in No. U-1116 on card, pg. 17

Bolted stirrup clamp

Protection against accidental removal during installation is provided by the novel main wire snap grip of the new SC series of bolted stirrup clamps offered by the Jasper Blackburn Corp., 1525 Woodson Road, St. Louis 14, Mo.

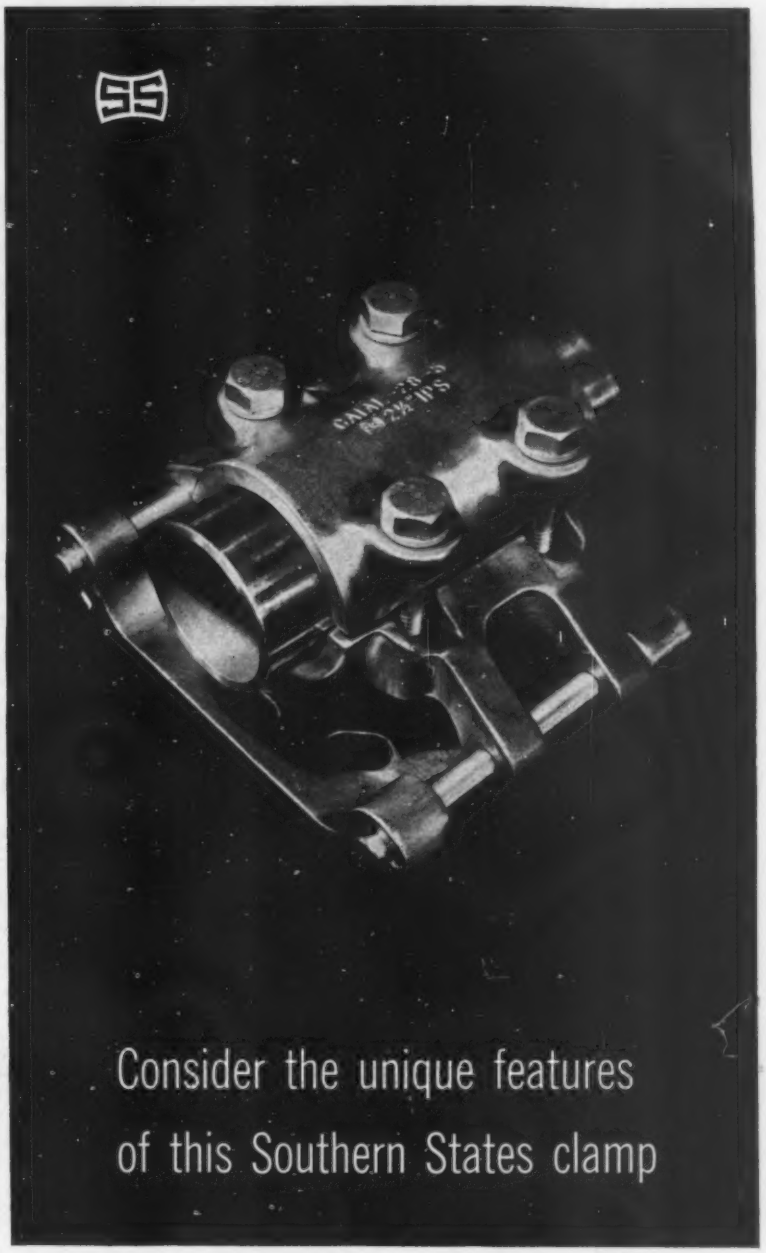
Stirrup ends are specially contoured to provide a strong mechan-



ically interlocked electrical connection to the clamp body. This connection is then permanently compression-sealed against oxidation or corrosion.

Only two clamps are required to cover a main wire range from No. 4 AWG to 397.5 ACSR. Aluminum or copper stirrups are furnished either straight or angled. Hex or eye nuts are optional.

Write in No. U-1117 on card, pg. 17



This exclusive design offers many advantages in a sliding bus support clamp: two stainless steel excursion rods... wide support to provide high cantilever strength... movement in only one direction — no pivoting or side chatter... heat-treated, high strength aluminum... anodized bolts. The Type CAIAL is another example of Southern States engineering.

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA Dominion Cutout Co., Ltd., Toronto

New series of tables extended to include larger hourly rates

A NEW SERIES of estimating tables, completely revised in the light of more recent jobs and experience, are presented in this issue and will appear from month to month in forthcoming issues. These electrical estimating data sheets cover labor only and are arranged alphabetically with the basic material headings as a title for each tabulation.

Labor units given in these tabulations are based on a minimum of interference during work progress. The averages listed do not provide for abnormal job conditions, and any such abnormal conditions will require adjustments by the user, based on his experience.

The work units covered by each table are composed of one or more separate but closely related operations necessary for the complete installation of a particular basic item of electrical equipment. These operations associated with the basic material are described at the bottom of each table.

Most of the electrical estimating tabulations follow the same form. Column 1 at the left shows the size of the material to be installed. The second column from the left gives the time required to install the material, and it should be noted especially that this "productivity" column may be based on individual units or in the case of cable or conduit on units of 100 feet or 1,000 feet. The abbreviations "Ea." for each, "C" for hundreds, and "M" for thousands in Column 2 indicate the basis of the labor hours.

Columns 3 to 13, from the left, give the actual labor costs in dollars per unit of installation, at various hourly wage rates.

When calculations are being made for an hourly wage rate that doesn't correspond to any of the rates listed in Columns 3 to 13, the user may multiply the number of hours in Column 2 by 100 and this will give the labor cost based on an hourly wage rate of $1 per hour. By multiplying this by the hourly wage rate that actually applies in the user's locality, the exact labor cost of the operation may be obtained. Labor costs obtained in this way will be for units, hundreds of feet, etc., as given in heading of Column 2 of the table.

The labor units covered by the tables represent direct job labor costs and do not include delivery of material to site, engineering, estimating, or any other indirect cost.

As will be noted, some of the electrical estimating tabulations to be given will be for independent operations, such as excavating, backfilling, etc. These are included for use in preparing estimates on work of a special nature not covered under a specific table heading.

Tables will appear in alphabetical order.

CONDUIT IN CONCRETE WAREHOUSE'S
THIN WALL

SURFACE MOUNTED

COND. SIZE	HOURS PER "C"	LABOR COST INSTALLED PER FT. AT FOLLOWING RATES										
		$2.00	$2.25	$2.50	$2.75	$3.00	$3.25	$3.50	$3.75	$4.00	$4.25	$4.50
1/2"	7.1	.142	.16	.178	.195	.213	.231	.249	.266	.284	.302	.32
3/4"	7.6	.152	.171	.19	.209	.228	.247	.266	.285	.304	.323	.342
1"	9.0	.18	.203	.225	.248	.27	.293	.315	.338	.36	.383	.405
1 1/4"	12.1	.242	.272	.303	.333	.363	.393	.424	.454	.484	.51	.54
1 1/2"	14.2	.284	.32	.355	.391	.426	.462	.497	.53	.57	.60	.64
2"	19.6	.392	.441	.49	.54	.59	.64	.69	.74	.78	.83	.88
					RIGID							
1/2"	7.4	.148	.167	.185	.204	.222	.241	.259	.278	.296	.315	.333
3/4"	8.2	.164	.185	.205	.226	.246	.267	.287	.308	.328	.349	.369
1"	9.5	.19	.214	.238	.261	.285	.309	.333	.356	.38	.404	.428
1 1/4"	12.8	.256	.288	.32	.352	.384	.416	.448	.48	.51	.54	.58
1 1/2"	16.1	.322	.362	.403	.443	.483	.52	.56	.60	.64	.68	.72
2"	20.5	.41	.461	.51	.56	.62	.67	.72	.77	.82	.87	.92
2 1/2"	26.1	.52	.59	.65	.72	.78	.85	.91	.98	1.04	1.11	1.17
3"	34.3	.69	.77	.86	.94	1.03	1.11	1.20	1.29	1.37	1.46	1.54
4"	53.2	1.06	1.20	1.33	1.46	1.60	1.73	1.86	2.00	2.13	2.26	2.39
5"	87.8	1.76	1.98	2.20	2.41	2.63	2.85	3.07	3.29	3.51	3.73	3.95
6"	123.9	2.48	2.79	3.10	3.41	3.72	4.03	4.34	4.65	4.96	5.27	5.58

E-101-B

LABOR: INCLUDES HANDLING MATERIAL AT SITE, DRILLING OR NOTCHING ACCESS HOLES, BENDING AND OFFSETS, INSTALLING ANCHORS, CUTTING, THREADING AND REAMING AND INSTALLING CONDUIT AND ATTACHING AT TERMINUS.

11-60

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CONDUIT IN WOOD STORE BUILDINGS

SURFACE MOUNTED — THIN WALL

COND. SIZE	HOURS "C"	LABOR COST INSTALLED PER FT. AT FOLLOWING RATES										
		$2.00	$2.25	$2.50	$2.75	$3.00	$3.25	$3.50	$3.75	$4.00	$4.25	$4.50
1/2"	6.7	.134	.151	.168	.184	.201	.218	.235	.251	.268	.285	.302
3/4"	7.0	.14	.158	.175	.193	.21	.228	.245	.263	.28	.298	.315
1"	8.5	.17	.191	.213	.234	.255	.276	.298	.319	.34	.361	.383
1 1/4"	11.4	.228	.257	.285	.314	.342	.371	.399	.428	.456	.485	.51
1 1/2"	13.3	.266	.299	.333	.366	.399	.432	.466	.499	.53	.57	.60
2"	18.3	.366	.412	.458	.50	.55	.59	.64	.69	.73	.78	..82
						RIGID						
1/2"	7.2	.144	.162	.18	.198	.216	.234	.252	.27	.288	.306	.324
3/4"	7.9	.158	.178	.198	.217	.237	.257	.277	.296	.316	.336	.356
1"	9.1	.182	.205	.228	.25	.273	.296	.319	.341	.364	.387	.41
1 1/4"	12.4	.248	.279	.31	.341	.372	.403	.434	.465	.496	.53	.56
1 1/2"	14.5	.29	.326	.363	.399	.435	.471	.51	.54	.58	.62	.65
2"	19.8	.396	.446	.495	.54	.59	.64	.69	.74	.79	.84	.89
2 1/2"	23.0	.46	.52	.58	.63	.69	.75	.81	.86	.92	.98	1.04
3"	33.4	.67	.75	.84	.92	1.00	1.09	1.17	1.25	1.34	1.42	1.50
4"	51.3	1.03	1.15	1.28	1.41	1.54	1.67	1.80	1.92	2.05	2.18	2.31
5"	85.2	1.70	1.92	2.13	2.34	2.56	2.77	2.98	3.20	3.41	3.62	3.83
6"	131.7	2.63	2.96	3.29	3.62	3.95	4.28	4.61	4.94	5.27	5.60	5.93

E-101-B

LABOR: INCLUDES HANDLING MATERIAL AT SITE, DRILLING OR NOTCHING ACCESS HOLES, BENDING AND OFFSETS, INSTALLING ANCHORS, CUTTING THREADING AND REAMING AND INSTALLING CONDUIT AND ATTACHING AT TERMINUS.

11-60

CONDUIT IN CONCRETE STORE BUILDINGS

SURFACE MOUNTED — THIN WALL

COND. SIZE	HOURS "C"	LABOR COST INSTALLED PER FT. AT FOLLOWING RATES										
		$2.00	$2.25	$2.50	$2.75	$3.00	$3.25	$3.50	$3.75	$4.00	$4.25	$4.50
1/2"	7.7	.154	.173	.193	.212	.231	.25	.27	.289	.308	.327	.347
3/4"	8.5	.17	.191	.213	.234	.255	.276	.298	.319	.34	.361	.383
1"	9.9	.198	.223	.248	.272	.297	.322	.347	.371	.396	.421	.446
1 1/4"	13.4	.268	.302	.335	.369	.402	.436	.469	.50	.54	.57	.60
1 1/2"	15.7	.314	.353	.393	.432	.471	.51	.55	.59	.63	.67	.71
2"	21.4	.428	.482	.54	.59	.64	.70	.75	.80	.86	.91	.96
						RIGID						
1/2"	8.3	.166	.187	.208	.228	.249	.27	.291	.311	.332	.353	.374
3/4"	8.9	.178	.20	.223	.245	.267	.289	.312	.334	.356	.378	.401
1"	10.4	.208	.234	.26	.286	.312	.338	.364	.39	.416	.442	.468
1 1/4"	14.1	.282	.317	.353	.388	.423	.458	.494	.53	.56	.60	.63
1 1/2"	16.5	.33	.371	.413	.454	.495	.54	.58	.62	.66	.70	.74
2"	22.6	.452	.51	.57	.62	.68	.73	.79	.85	.90	.96	1.02
2 1/2"	26.1	.52	.59	.65	.72	.78	.85	.91	.98	1.04	1.11	1.17
3"	37.8	.76	.85	.95	1.04	1.13	1.23	1.32	1.42	1.51	1.61	1.70
4"	58.4	1.17	1.31	1.46	1.61	1.75	1.90	2.04	2.19	2.34	2.48	2.63
5"	96.8	1.94	2.18	2.42	2.66	2.90	3.15	3.39	3.63	3.87	4.11	4.36
6"	136.2	2.72	3.06	3.41	3.75	4.09	4.43	4.77	5.11	5.45	5.79	6.13

E-101-B

LABOR: INCLUDES HANDLING MATERIAL AT SITE, DRILLING OR NOTCHING ACCESS HOLES, BENDING AND OFFSETS, INSTALLING ANCHORS, CUTTING, THREADING AND REAMING AND INSTALLING CONDUIT AND ATTACHING AT TERMINUS.

11-60

Electrical Estimating—III

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Know the law

by Arthur L. H. Street

Municipality licensing electrical contractors

THE PROBLEM: In a state where, apparently, there is no provision for *state* licensing of electrical contractors, the legislature authorized municipalities to "regulate" electrical installations, etc. There is also a general state law empowering municipalities to safeguard by ordinance the public health, safety, etc. Did this authorize a city to adopt an ordinance requiring electrical contractors to secure licenses after demonstrating their qualifications to engage in that business?

COURT'S ANSWER: No. So decided the Iowa Supreme Court in the case of Mason City v. Zerble, 93 N.W. 2d 94. The court recognized that in some states the courts have decided that power of a municipality to "regulate" an occupation implies power to require those engaging in it to secure a municipal license. But the Iowa court inferred that the legislature of that state has manifested intention to the contrary, because other statutes conferred power to "regulate *and license*" certain occupations.

In other words, usually when the Iowa legislature has intended to confer the power to license it has authorized regulation and *licensing*, not merely *regulation*. When similar question shall rise in other states the courts may be influenced by this decision in reaching their own conclusions.

Scope of the ordinance

Section 20 of the ordinance read:

"Licenses Required. No person, firm or corporation shall engage in the business of installing, maintaining, altering or repairing any electrical equipment within the scope of this ordinance unless such person, firm or corporation shall have obtained from the City of Mason City an Electrical Contractor's license, nor shall any such Electrical Contractor employ any but licensed electrical journeymen, employed by and working under, the direction of the holder of the license for one of the classes of licenses prescribed by this ordinance for apprentices working under the supervision, direction and control of a licensed electrical journeyman; except that the holder of existing electrical licenses or certificates granted by the city may be issued renewals of their licenses or certificates without taking the examinations herein provided for; and also with the exception that no license shall be required in order to execute or perform any of the classes of electrical work exempted by the provisions of this ordinance. No license shall be required for the following described work:

"(a) Any of the three (3) classes of electrical work for which no permit is required as provided in Section 7 hereof."

"(b) Any work involved in the erection, installation, repairing, remodeling or maintenance of elevators, dumb-waiters or escalators, not including electrical equipment for supplying current to the control panels of elevators, dumb-waiters or escalators."

"(c) The assembly, erection and connection of electrical equipment by the manufacturer of such equipment, but not including any electrical equipment other than that involved in making electrical connections on the equipment itself, or between two or more units of said equipment."

Section 20 provides for three classes of licenses: An electrical contractor's license, an electrical maintenance license, and an electrical journeyman's license. Section 21 fixes the annual fees to be charged for licenses. Section 23 requires the holder of a class L or electrical contractor's license to furnish a $5,000 bond with conditions not important here. The ordinance requires a permit from the city before any major electrical work can be done, and that no one except a holder of a class L license, the electrical contractor's license, may apply for or secure this permit.

Municipal power is limited

The court said that the case was governed by these fundamental rules of law:

Municipal corporations are wholly creatures of the legislature.

Municipal corporations possess and can exercise only the powers (1) expressly granted by legislature, (2) necessarily or fairly implied in or incident to powers expressly granted, and (3) indispensably essential—not merely convenient—to declared objects and purposes of municipality.

Generally, a grant of power to municipalities to regulate includes the power to license, within reasonable limits.

Under statutes, when legislature meant to grant power to license it was essential to use the word "license."

Grants of power to municipalities are strictly construed against authority claimed, and where there is uncertainty or reasonable doubt as to its existence it must be denied.

Year's wait can affect oral contract validity

IN MOST, if not all, states there is a statute to the effect that an agreement not to be performed within one year from the making thereof shall not be binding unless evidenced by a writing signed by the party to be bound. The Kentucky Court of Appeals lately decided that, under such a statute, an oral agreement by defendant, made in May, to employ plaintiff for one year commencing August 1st, was not binding where defendant refused to permit plaintiff to start working. (Willis v. Willis, 329 SW 2d 205.)

But had defendant permitted plaintiff to begin work August 1, then the contract would have been validated *for one year from that date.*

Tenant's liability on electrical bill

WHEN A BUSINESS is conducted on leased premises forming only part of a building that receives electrical services, and repairs are partly for the exclusive benefit of the lessee and partly for the benefit of the entire building, an electrical contractor undertaking to make the repairs at the instance

(Continued on page 130)

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TRENTON, NEW JERSEY

Understanding the Code

By Walter R. Stone

This article should be especially helpful to the following readers:

Electrical Contractors
Electric Utilities
Electrical Wholesalers
Electrical Inspectors
Industrial Engineers
Consulting Engineers

◆ SWITCHES and circuit breakers which are used for motor disconnecting means are required by Section 430-101 of the Code to be ". . . capable of disconnecting motors and controllers from the circuit." The requirements for this "capability" are not the same for all motors, however. In other words, the disconnecting means is required to be either a circuit breaker or a motor circuit switch rated in horsepower for some motors but not for others.

For instance, the disconnecting means for a stationary motor of not over 1/8 hp may be a plug fuse as permitted by Section 430-109(a). Very few, if any, competent electricians, however, would make an installation which depended upon using any type of fuse for a disconnecting means for any size motor or for anything else.

For stationary motors larger than ⅛ hp, the requirements for the disconnecting means are much more strict.

For motors of 2 hp or less and 300 volts or less, the disconnecting means may be a general-use switch with an ampere rating not less than twice the motor full-load current rating. For a-c motors, a general-use a-c snap switch may be used where the motor full-load current rating does not exceed 80 per cent of the switch rating. (General-use a-c/d-c snap switches cannot be used for this purpose.)

Motor range 2 to 50 hp

For stationary motors larger than 2 hp, but not larger than 50 hp, the motor disconnecting means is required by Section 430-109 to be either a circuit breaker or a motor circuit switch rated in horsepower except that for a motor with an auto-transformer type of controller, a general-use switch may be used where *all* of the following provisions are met:

"(1) The motor drives a generator which is provided with overcurrent potection.

"(2) The controller (1) is capable of interrupting the stalled-rotor current of the motor, (2) is provided with a no-voltage release, and (3) is provided with running-overcurrent protection not exceeding 125 per cent of the motor full-load current rating.

"(3) Separate fuses or a circuit-breaker, rated or set at not more than 150 per cent of the motor full-load current, are provided in the motor branch circuit."

As stated above, *all* of the provisions in the above quoted paragraphs must be complied with as well as the use of a transformer type controller before a general-use switch is permitted to be used for the disconnecting means for a

Code test questions

1. For stationary motors of ⅛ hp or less, a plug fuse may serve as the disconnecting means. True or false?

2. Every switch in the motor branch circuit which is within sight of the motor controller is required to be a motor circuit switch rated in horsepower for an across-the-line full-voltage-start motor of over 2 hp up to and including 50 hp. True or false?

3. Attachment caps and receptacles are not permitted to be used as the disconnecting means for portable motors of over 2 hp. True or false?

4. The disconnecting means shall have a carrying capacity at least equal to 115 per cent of the nameplate current rating of the motor. True or false?

5. The motor running overcurrent (overload) protective device for a motor of over 600 volts shall be a device other than a circuit-breaker, and it shall be in a separate enclosure from the controller. True or false?

6. Motors shall be installed in fire resistant motor rooms if the operating voltage exceeds:
(a) 300 volts.
(b) 600 volts.
(c) 7500 volts.
Which is correct? a? b? or c?

7. Exposed live parts of motors and controllers shall be guarded against accidental contact by enclosure or by location if the operating voltage between terminals is:
(a) 50 volts or more.
(b) 150 volts or more.
(c) 600 volts or more.
Which is correct? a? b? or c?

8. The frames of stationary motors shall be grounded where the motor operates with any terminal at more than:
(a) 50 volts to ground.
(b) 150 volts to ground.
(c) 600 volts to ground.
Which is correct? a? b? or c?

9. Controller cases, except those attached to ungrounded portable equipment and except the lined covers of snap switches, are required to be grounded:
(a) only if the voltage exceeds 250 volts to ground.
(b) only if the voltage is 750 volts or more between conductors.
(c) regardless of the voltage.
Which is correct? a? b? or c?

10. A junction box to house the motor terminals of a fixed motor may be separated from the motor not more than:
(a) 18 inches.
(b) 6 feet.
(c) 10 feet.
Which is correct? a? b? or c?

Correct answers may be found at end of article on page 107.

motor in this size range. Otherwise, either a circuit-breaker or a motor circuit switch rated in horse-power is required.

Motors above 50 hp

For a stationary motor larger than 50 hp, the disconnecting means may be a general-use switch or even an isolating switch. Isolating switches, where so used, are required to be marked plainly: "Do not open under load."

The disconnecting means for a portable motor of *any* size may be an attachment cap and receptacle. For large portable motors, the attachment caps and receptacles usually are designed especially for the motors which are to be plugged in, such as for large motors on oil barges which plug into receptacles that have been installed especially for them on the docks. This provides plug-in power for unloading the barges without the barges having to provide power for running the large motors. (Although not required by the Code, such large plug-in devices are usually provided with circuit-breakers or motor circuit switches ahead of the receptacles.)

The motor disconnecting means is required by Section 430-102 to be located within sight of the motor controller or be capable of being locked in the open position.

The motor disconnecting means is required by Section 430-103 to disconnect the motor controller as well as the motor itself from all ungrounded supply conductors in the motor circuit. In other words, when the motor disconnecting means is open, there should be no current to any conductor leading to either the motor or to the motor controller, except that the control circuit, *as distinct from the motor circuit supplying the controller*, may be provided with a separate disconnecting means.

In such cases where the control circuit is provided with a separate disconnecting means, as permitted by Section 430-74, both this control circuit disconnecting means as well as the motor disconnecting means would have to be open, of course, before the controller would be "dead."

Where two disconnecting means are used, they should be adjacent one to the other. (See Section 430-74 and this department in the October, 1960, issue of ELECTRICAL SOUTH.) Where the control circuit has a separate disconnecting means, current to the control circuit will not supply current to the motor when the motor disconnecting means is open.

Section 430-104 requires the motor disconnecting means to be so designed that they will indicate whether they are in the open or the closed position.

Grounded conductors are usually, and preferably, not opened by the motor disconnecting means. However, this conductor may be so opened but only as permitted by Section 430-105 which requires in such cases that all ungrounded conductors of the circuit be disconnected simultaneously with the grounded conductor.

A service switch is not permitted to be used as the motor disconnecting means unless the total load connected to the service switch consists of a single motor only. This eliminates lights or any load whatsoever other than the single motor. Even then the service switch, to be so used, is required by Section 430-106 to be suitable and approved for the purpose (for the type and size of motor, etc.) according to the provisions of Article 430 and to be within sight of the motor controller or be capable of being locked in the open position.

Motor disconnecting means are required by Section 430-107 to be readily accessible.

A special requirement

Section 430-108 requires every switch in the motor circuit which is within sight of the motor controller to comply with the provisions of Part H of Article 430. This means, for instance, that where, by these provisions, a motor disconnecting means is required to be a circuit-breaker or a motor circuit switch rated in horsepower, a plain isolating or general-use switch cannot be placed within sight of the motor or its controller even though a proper disconnecting means has already been provided somewhere else in the circuit.

On the other hand, if a circuit-breaker or switch which meets these requirements has been placed within sight of the motor controller, then a general-use switch may be placed in the same motor circuit but out of sight from the motor controller, such as at a remote point of supply for the motor branch circuit.

Although the Code does not specify a maximum size requirement for motor disconnecting means, Section 430-110 does provide a minimum size requirement for such devices. (Section 430-52, as discussed in the September, 1960, issue of ELECTRICAL SOUTH, specifies maximum size requirements for motor branch-circuit short-circuit and ground-fault protective devices. This, in turn, has the effect of placing a maximum size on the disconnecting means.)

Actually, however, where the required overcurrent protective devices do not exceed Code requirements, there would not be a Code violation if, say, a 50 hp unfused safety switch were to be installed as the disconnecting means for a 5 hp motor or, as far as that goes, for a 1/8 hp motor. As stated above, however, there is a minimum size for motor disconnecting means.

Minimum switch sizes

This minimum, which is required for all motors by Section 430-110, but which is superseded for some motors by the minimum horsepower ratings required by Section 430-109 discussed above, is that the disconnecting means must have a current-carrying capacity of at least 115 per cent of the motor nameplate full-load current rating.

Sealed hermetic-type refrigeration compressor motors have this 115 per cent minimum requirement, also. But where minimum horsepower ratings are also required for some sizes, the correct horsepower rating can be determined by Tables 430-148 through 430-150 and from Table 430-151, selecting the next higher rating where the nameplate and locked rotor currents do not correspond with the currents shown in Tables 430-148 through 430-150. If two different horsepower ratings are obtained when applying Tables 430-148 through 430-150 on the one hand and Table 430-151 on the other, the larger of the two ratings must be used.

Combination switches

Certain types of switches or circuit-breakers may, by the provisions of Section 430-111, be used as a combination motor disconnecting means and motor controller. For the relatively rare occasions where this may be desired, the switches or circuit-breaker so used must comply with the requirements of Section 430-83 for controllers. (These requirements were discussed in the October, 1960, issue of ELECTRICAL SOUTH) In addition, the device so used must open all ungrounded conductors to

the motor, must be protected by an overcurrent device which opens all ungrounded conductors supplying it, and must be one of the following types:

(1) A manually operable air-break switch; (2) a manually operable circuit-breaker; or (3) an oil switch where the circuit rating does not exceed 600 volts or 100 amperes unless under expert supervision in which case higher ratings may be used by special permission. An auto-transformer type controller is not included in this category. Where this type controller is used, there must be a disconnecting means which is separate from the controller.

Each motor is required by Section 430-112 to have its own separate disconnecting means except as follows for motors of 600 volts or less:

(1) Two or more used to drive the several parts of a single machine, such as wood working machines or cranes, may have a single disconnecting means for the entire group.

(2) Two or more motors each not exceeding 6 amperes or 1 horsepower may be used on a single branch circuit protected at not more than 20 amperes at 125 volts or less, and 15 amperes at 600 volts or less.

(3) Two or more motors which are within a single room and within sight of a single disconnecting means are not required to have individual disconnecting means on each motor. Where a single disconnecting means is permitted to be used for a group of motors, the disconnecting means so used is required to have a rating equal to the rating which would be required for a single motor with a current rating equal to the *sum* of the horsepowers or current of *all* of the motors in the group. The rating based on this sum applies to the disconnecting means only and *not* to any overcurrent devices.

Voltages above 600

Motors which operate at potentials exceeding 600 volts have provisions in addition to those for motors which operate at potentials of 600 volts or less. These additional provisions, as stated in Section 430-121, are in recognition of "... the additional hazard due to the use of high voltage."

Motors operating at more than 7,500 volts between conductors are required by Section 430-122 to be installed in fire resistant motor rooms.

Motor running overcurrent (overload) protection for motors of over 600 volts is required by Section 430-123 to be either a circuit-breaker or an overcurrent device integral with the motor controller which, in the event of an overload, will simultaneously open *all* — repeat — open *all* ungrounded motor conductors.

Special provisions for short-circuit and ground-fault overcurrent protective devices for motors of over 600 volts are required by Section 430-124. This section states that one of the following types of overcurrent devices shall be provided for such high voltage motors:

"(a) A circuit-breaker of suitable rating so arranged that it can be serviced without hazard.

"(b) Fuses of the oil-filled or other suitable type. Fuses shall be used with suitable disconnecting means or they shall be of a type which can also serve as the disconnecting means. They shall be so arranged that they cannot be re-fused or replaced while they are energized.

"(c) Differential protection may be employed to protect an alternating-current motor, the motor control apparatus, and the branch-circuit conductors against overcurrent due to short circuits or grounds. When all these elements are included within the protected zone of a differential protective system, the ratings or settings specified in Section 430-52 do not apply."

The ratings or settings specified in Section 430-52 referred to above are those which enable the motor to start without needlessly operating the short-circuit overcurrent protective devices and which are required to be within the maximum percentage limits listed in Tables 430-152 and 430-153. When differential overcurrent potective devices are used the relay elements respond to a predetermined difference between the value of the ingoing and outgoing currents entering and leaving the protected zone.

Differential protection

A simplified sketch of a current-differential relay protective system is illustrated in Figure 1 (A). The system between the current transformers (marked CT) is the protected zone. This zone could be a portion of a circuit, as shown, or it could be a motor winding. The secondaries of the CTs are joined, and the coil of an overcurrent relay (marked OC) is connected across this circuit. The primary current flow, indicated by the arrow heads, causes the secondary current to flow as indicated by arrow heads in the secondary circuit. Since this flow is balanced, no current flows through the overcurrent relay.

If a fault, such as a short-circuit, develops, however, in the protected zone as indicated by the X in Figure 1 (B), then current will flow through the overcurrent coil and cause it to operate, opening the circuit-breaker to the load.

A percentage-differential relay

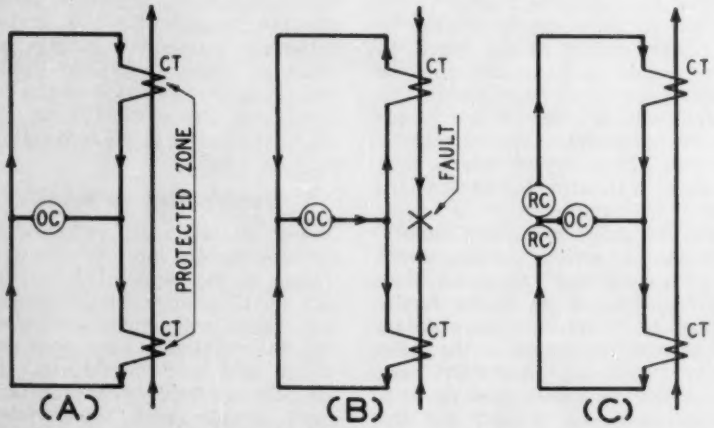
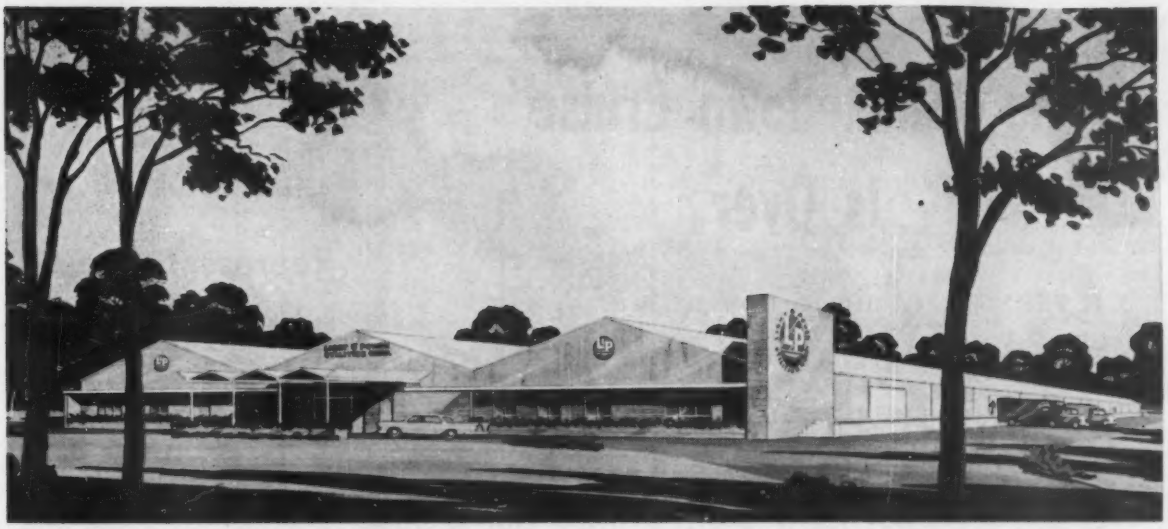


Fig. 1—A simplified current-differential relay system is shown at (A). The same system is shown in (B) but with a fault and fault current flowing in overcurrent coil OC. A percentage-differential relay system is shown in (C). Large high voltage motors are usually protected by a system similar to that shown in (C). RC indicates restraining coils.



The New L & P Catalog Is —

BIG... BRIGHT... and USEFUL

Just off the press is the biggest catalog in L & P's history — and the most informative and easy-to-use. Containing over 200 pages, this bright and colorful catalog has new pictures of every lighting fixture in the L & P fluorescent and Delta incandescent lines.

Among the fluorescent fixtures included are enclosed commercials, open commercials, industrials, strips, corridors, troffers and squares, and illuminated ceilings. Clear and helpful descriptions of the type, construction, electrical specifications, mounting and finish of each fixture are given, as well as ordering information and test, dimensional, and mounting data.

Nearly 100 pages of the new book are devoted to similarly complete illustrations and descriptions of L & P's full Delta incandescent line. Among the many types included here are concentric rings, hi hats, squares, rounds, bullets, up-down lites, bracket lites, exit lites, etc. Spot illustrations suggest uses for each fixture, and details of electrical data, finish, dimensional data and ordering information are given.

Most outstanding feature of this new catalog is the down-to-earth, practical manner in which it was designed and produced. It was designed as a real working tool for everyone who must specify lighting fixtures, and it succeeds in being just that. Tabbed index pages for each section make it easy to find any desired type of fixture in seconds.

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Gerald Preacher (F - I)
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Irvin Spero (F)
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Arthur H. Swartz (F - I)
2120 Polk Ave.
Houston, Texas

Light & Power Utilities Corp. (F-I)
P. O. Box 157
Olive Branch, Mississippi

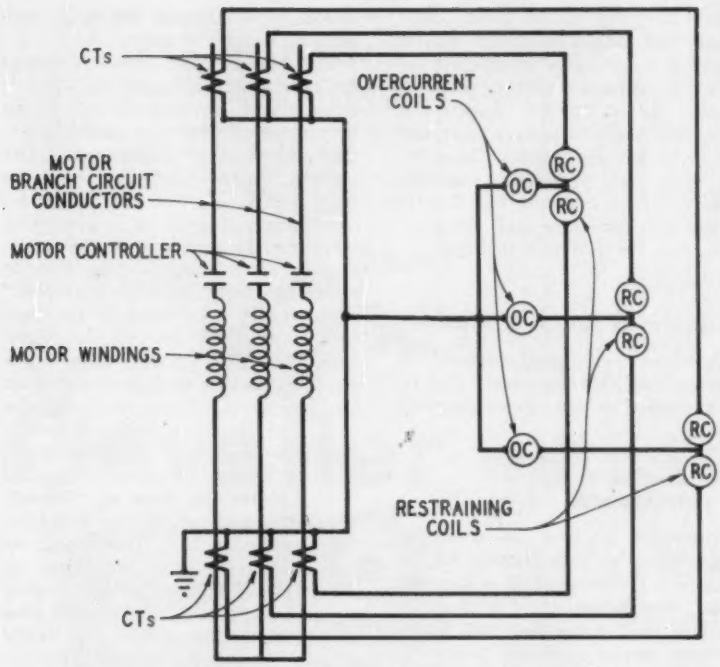


Fig. 2—This diagram shows how a percentage-differential relay system would be connected to protect a motor, its branch circuit conductors, and its controller. Overcurrent coils—OC; restraining coils—RC.

is very similar to the current-differential relay. Percentage- differential relays are usually provided for large motors operating on high voltages. The advantage of percentage-differential relays for such motors is that they will not operate on starting currents, yet they provide faster protection from short-circuits.

This type system is illustrated in Figure 1 (C). This system has a restraining coil tapped at the midpoint of the winding or two separate restraining coils each with the same number of turns connected as shown (marked RC). This type of relay is less likely to operate incorrectly from slight variations in the CT secondaries when a short-circuit occurs outside of the protected zone than a current-differential relay.

Figure 2 shows percentage-differential relays connected at each end of a motor winding in such a way that the motor, the motor branch circuit conductors, and the motor controller are all within the protected zone.

Protection of live parts

Section 430-131 seems at first reading to place considerable responsibility on the shoulders of local inspection authorities. It states, "The provisions of Part K specify that live parts shall be protected in a manner judged adequate to the hazard involved. On closer scrutiny, however, this is seen to be merely a proclamation of what is intended by the rules immediately following in Sections 430-132 and 430-133.

These rules require that live parts of motors be enclosed, isolated, elevated, or guarded against accidental contact by anyone and particularly by unqualified persons. Where adjustments have to be made to live parts during regular operation procedures, such as to brushes and collector rings or commutator bars, insulated platforms or mats are required to be placed so that the live parts can be reached only when standing on such insulated mats. Protection from moving parts is also required to be provided by the installation of railings where needed.

Part L of Article 430 requires that motors be grounded except where insulation, isolation, or guarding may be suitable alternatives. Grounding for stationary motors is required by Section 430-142 (a) when metal-clad wiring systems are used; (b) when in a wet location and not out of reach; (c) when in hazardous locations; and (d) when operating at more than 150 volts to ground.

Where stationary motors are not grounded, they are required to be permanently and effectively insulated from ground.

Portable motors operating at more than 150 volts to ground are required by Section 430-143 to be either grounded or guarded. This section also refers to Section 250-45(d) for grounding requirements of portable appliances in other than residential occupancies. Such appliances are required to be grounded if in wet locations and if within reach of a person standing on ground or grounded surface.

Motor controller enclosures are required by Section 430-144 to be grounded regardless of voltage. The only exceptions are the lined covers of snap switches and controller cases which are attached to ungrounded portable equipment.

In the next issue, generators and transformers will be discussed.

Answers to Code test questions: (1. **T** Section 430-109-a) (2. **T** Section 430-108) (3. **F** Section 430-109-e) (4. **T** Section 430-110) 5. **F** Section 430-123) (6. **c** Section 430-122) (7. **a** Section 430-132) (8. **b** Section 430-142-d) (9. **c** Section 430-144) (10. **b** Section 430-145-b).

Protective device for portable tools

◆ From Johannesburg, Union of South Africa, Peter Holz sends details of a new safety device which has been most effective in that area. It is a device that will prevent fatal accidents caused by defective power tools or appliances —believed to be the first of its kind in the world. It is being manufactured at the Springs works of Henley-Simplex, and the company expects that a world-wide market for it will speedily develop.

The same principles will soon be incorporated into devices that will provide safety in homes where electrical appliances like washing machines, ranges, and irons are in daily use.

Last year, 22 people were electrocuted by electric tools or appliances in the Union of South Africa and another 24 were seriously injured. In the United States there were 86 fatalities. Figures for other countries are not available, but it is estimated that the world-wide toll ran into many hundreds.

The safety problem has occu-

pied electrical engineers and designers for many years, but the new invention represents a breakthrough in this field. It incorporates sensitive earth-leakage protection, operating on the current-balance principle.

The two current carrying conductors connected to an electrical appliance in good condition carry precisely equal currents in opposite directions. If there is a current leakage to earth, the two currents will become unequal, differing by the amount of current flowing through the earth path. The current balance device is sensitive to this difference, and causes a double-pole circuit-breaker to trip when the difference or leakage current exceeds a given value, thereby disconnecting the apparatus.

The Henley-Simplex device will trip out the breaker if the earth leakage is as little as half a milliampere, but this can be adapted to meet the user's needs. This provides a wide safety margin because a current of nine milliamperes is generally accepted as a safe "let-go" current for the average man.

Furthermore, the time to which a human is exposed to the flow of current while using a defective tool connected to the unit is also kept well within the limits of safety because a five-milliampere fault will be cleared in approximately 70 milliseconds, and a 15-milliampere fault in only 30 milliseconds.

The Henley-Simplex device, therefore, offers unparalleled protection for the user of a portable tool or appliance. Up to three electrical tools can be connected to it in the smaller factory or workshop. Where, however, large numbers of power tools are in use, a suitably adapted unit can be incorporated into the distribution board controlling the plug circuits and this will protect all the apparatus simultaneously. Such an installation is relatively inexpensive, amounting to only a fraction of the cost, say, of providing isolated power supplies for all tools at a lower voltage.

The electronic components used to amplify the small response from the current balance detector, which trips the breaker, show no signs of deterioration due to ageing. Prototypes tested in a national laboratory have made as many as ten thousand consecutive trips with no noticeable change in performance. An added safety factor is provided by three neon indicators that flash warnings if the supply is incorrectly connected.

As a final safety factor, there is a test button which applies a simulated fault to ensure that the unit is in working order. The device will not prevent a person from receiving a shock, but it will reduce its duration and severity sufficiently to prevent injury.

Questions on the Code

(Readers are invited to send in questions which they would like to see discussed in this department.)

Safe location for switchboards

QUESTION: Section 384-6 seems to lend itself to expediency. As an inspector, I interpret this section to require placement of a switchboard in such a manner and location that easily ignitible material is not likely to become ignited, or that the probability of such ignition is extremely remote. But a contractor in my district has an entirely different interpretation. He contends that the section requires only that the switchboard be so placed as to be less likely to ignite such material than at any other placement or arrangement of the board would be in the desired location.

After listening to his argument and re-reading the section, it does seem to permit what he wants to do. But if his interpretation is correct, the section should be rewritten. By the terms of his reasoning, there could be a fifty-fifty chance of a fire and the inspector would still have to accept it provided that the arrangement he selected offered the minimum probability of a fire in relation to all other possible arrangements in the particular location he selected.

I insisted upon and finally got a safe installation by falling back on the definition of "approved" in Article 100 which says, "Acceptable to the authority enforcing this Code." As you know, however, inspectors would prefer to have explicit Code rules to back them up. I believe that most contractors would also prefer this.

ANSWER: Your interpretation conforms with the intent not only of Section 384-6, but also of the entire Code generally, since the intent of the Code is to obtain reasonable safety. Therefore, you were correct in insisting upon an installation which would insure a reasonable degree of safety.

Perhaps Section 384-6 is vague in a manner of speaking, for it does admit the possibility of an arrangement whereby easily ignitible material is "adjacent." The section states, "Location Relative to Easily Ignitible Material. Switchboards shall be so placed as to reduce to a minimum the probability of communicating fire to adjacent easily ignitible material."

However, switchboards do contain overcurrent devices. And Section 240-16(c) states that overcurrent devices shall be located on the premises where they will be ". . . not in the vicinity of easily ignitible material." Furthermore, Section 110-4 requires that all ". . . materials, devices, fittings, apparatus and appliances designed for use under this Code shall be judged chiefly with reference to . . . (d) Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service" and "(e) Arcing effects."

These rules, together with the clearance requirements in Section 384-8, will if followed "reduce to a minimum the probability of communicating fire to . . . easily ignitible material." Perhaps the word *adjacent* should be left out of this section. In any case, Section 384-8, besides requiring clearances, requires also that "The space back of the board shall be kept clear of foreign material and shall not be used for storage purposes, nor as passageways."

Misapplication of rule on multiple conductors

QUESTION: The Inspector has turned down a house wiring job where we installed two 100-ampere service entrance switches, one for electric heating circuits and one for lighting and appliance circuits, rather than install one 200-ampere switch. We ran No. 2, 3-conductor copper SE cable from the meter to each switch and 3/0 conductor from service drop to meter.

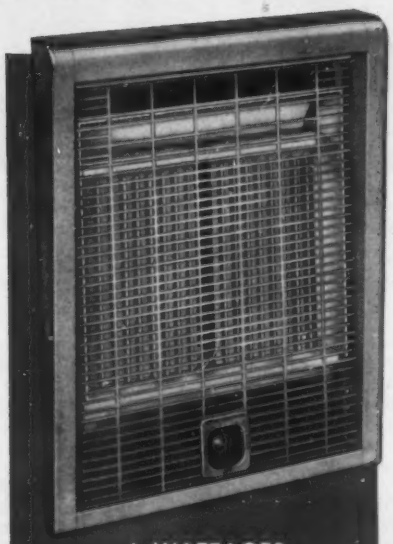
The Inspector explained that conductors smaller than 1/0 could not be used in multiple.

We believe this is not in violation of the Code because no conductor can be overloaded nor can it carry more current than if only one 100-ampere switch were installed.

(Continued on page 130)

NEW

Cavalier WALL INSERT HEATERS



6 WATTAGES

All sizes require wall opening 18½" high. Widths from 9¾" to 27¼". Wattages from 1.5 to 5 KW.

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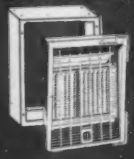
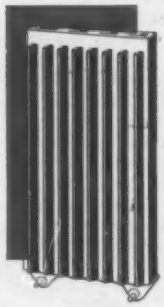


Provides simple, economical installation on masonry or where cutting into wall is objectionable.

TOTALLY ENCLOSED ELEMENTS!
New Safety, Beauty, Efficiency!

CAVALIER LEADS AGAIN WITH THE FIRST RADIANT CONVECTOR HEATER WITH TOTALLY ENCLOSED ELEMENT

Nickel-chromium wire embedded in cordierite ceramic, the finest ceramic known for heating elements. It has high strength, excellent resistance to heat shock, and is one of the most efficient electrical insulators. When heated, this enclosed element gives a cherry red glow with the cheerfulness of an open fire.



Patent No. 2,662,963 Other patents applied for

THESE ARE CAVALIER'S PROVEN QUALITY FEATURES:

ENAMELED GRILLE AND DEFLECTOR easily lifted out giving full access for easy cleaning.

IMPROVED DEFLECTOR throws heat away from the wall—keeps walls clean, circulates air outward into the room. NO LEDGE TO CATCH DIRT OR TEAR CLOTHING.

NEW POLISHED ALUMINUM REFLECTOR, hinged at bottom, tips forward for cleaning. New curved reflector gives more efficient air flow and circulation of heated air. J series heaters are so efficiently designed that the wall box temperature is exceptionally low.

DOUBLE BAFFLE below the main reflector gives more accurate temperature control—a patented feature.

SENSITIVE BULB is placed at bottom, air entering from side and bottom gives accurate temperature control.

HEAT CONTROL SWITCH—combined switch and thermostat control, the utmost in simplicity. Breaks both sides of the circuit.

NAILING FLANGES on steel wall box for quick and easy installation.

NAIL HOLES provided in side of wall box for mounting.

KNOCKOUT HOLE at bottom for lead wire.

10-YEAR WARRANTY ON HEATING ELEMENTS.

FIRST

in quality construction
in engineering advances
in safety
in sales-making features

ELECTRIC HEATING DIVISION

CAVALIER CORPORATION, Chattanooga 2, Tennessee

Our 95th Year of Quality Products

News of the industry

edited for Southern readers

Lighting Action Plan introduced by Graybar

BREAKING with traditional marketing role and functions, Graybar Electic Company, Inc., at the National Electrical Contractors Convention in Las Vegas announced the launching of a nation-wide market expansion program for the relighting modernization of commercial and industrial facilities—a potential five billion dollar market.

The new market expansion program, referred to as the Lighting Action Plan, has already received the active support and participation of more than 200 electrical utilities throughout the country, plus 12 of the nation's largest lighting fixture manufacturers, the world's largest lamp producer, and the electrical contractors who will be the primary users of the training and sales aids supplied by the program.

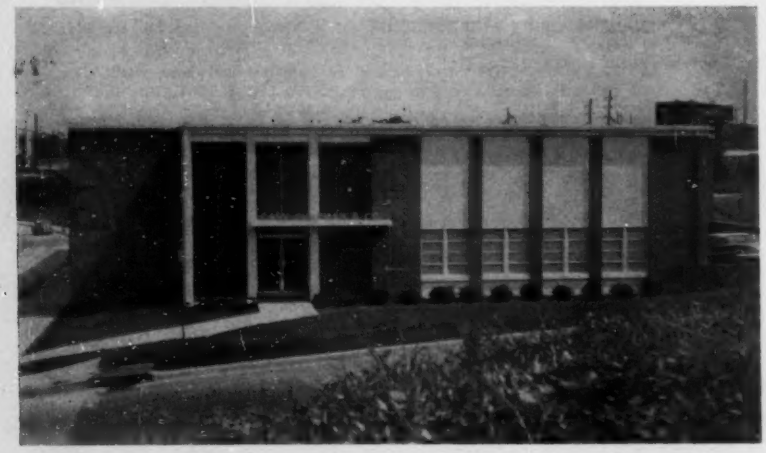
Electrical contractors will be interested in the many features of the Lighting Action Plan: sample fixtures, complete stocks, sales training, sales aids, a finance plan, a lighting tabloid, as well as other pertinent booklets and sales aids.

The new marketing program, built around a line of specially-engineered lighting fixtures, is based upon the increasing need for improved levels of illumination in "older" commercial and industrial facilities. Generally, older construction refers to buildings erected prior to 1950.

B. F. Benning, Graybar's general lamp and lighting sales manager, uses a bar graph to show W. E. Henges, president, how lighting levels have increased in the last ten years and their projected increase.

The Lighting Action Program will provide contractors with a complete package of training and selling aids concerning fixtures, lighting requirements, and the market. The package, for example, will contain a new light meter designed especially for use in the program. This new light meter has a rotary dial showing the recommended minimum lighting level for different areas within schools, offices, industrial plants, etc.

Also, in addition to sales aids and promotional literature, the program will supply a super-simplified lamp and lighting guide to give the contractor and user a quick understanding of the lighting needs in any given amount of space.



NEW BUILDING—Cary Chapman & Company has completed a new general office and warehouse building in Atlanta. The firm, an electrical and electronic manufacturers' representative, has been serving distributors in the Southeast since 1924, and at present has 12 salesmen covering nine states, and offices and warehouses in five Southern cities. Chapman & Company represents the following manufacturers: Arrow-Arrolet, Atlas, Bar-Brook, Clayton Mark, Collyer Wire, CBS Electronics, Fullman, Plymouth Rubber, and Royal Electric.

OG&E's Frank Kaspar becomes AIEE fellow

FRANK P. KASPAR, chief design engineer for Oklahoma Gas & Electric, recently was named a Fellow of the American Institute of Electrical Engineers.

The citation read: "For contribution during 30 years to design of substations, transmission, underground distribution, relaying and control, lightning protection, and electrical systems in generating stations for a large electric utility while expanding from 156 mw to 1,190 mw capacity."

Mr. Kaspar received his B.S. degree in electrical engineering from

Frank P. Kaspar is shown accepting the award in Oklahoma City.

the Milwaukee School of Engineering, and after graduation taught at the school. In 1920-21 he was employed by Wisconsin Electric Power Co. In 1924 he joined Public Utility Engineering and Service Company of Chicago as assistant squad leader in electrical design.

He was sent to Oklahoma City in 1928 as assistant resident engineer on the OG&E system, then a subsidiary of Standard Gas & Electric. In 1936 he was employed by OG&E as transmission and substation engineer and a few years later was made a chief design engineer.

IES picks Slauer as new president

RICHARD G. SLAUER, Sylvania executive, has been elected president of the Illuminating Engineering Society. Mr. Slauer took office at the Society's annual conference banquet, and received the gavel of office from retiring president Joe B. Browder, Atlanta utility executive.

Richard G. Slauer

Mr. Slauer was recently appointed manager of engineering—fixtures for

NEW
CIRCLE F
20-AMP
"U"-GROUND DEVICES

. . . Section 220-3 (b) of the 1959 National Electrical Code states . . .

"For the small appliance load in kitchen, laundry, pantry, dining room and breakfast room of dwelling occupancies, (1) 2 or more 20-ampere branch circuits in addition to the branch circuits specified in paragraph 220-3 (a) shall be provided for all receptacle outlets (other than outlets for clocks) in these rooms, and such circuits shall have no other outlets."

Designed to provide full compliance with the revised Code, Circle F's *new* No. 2532 does much more! It becomes a "universal" outlet! It accommodates appliances, heavy-duty portable tools, business machines, etc., having substantial energy requirements, where the new 20 A.-125 V. plug cap (No. 2528) is necessary. It also accommodates 15 A.-125 V. 3 wire U-ground and standard parallel blade caps. One outlet for all! Circle F's quality is tops and the price is right. Contact your Circle F representative for complete details.

CIRCLE F MFG. CO.
TRENTON 4. NEW JERSEY

Sylvania Electric Products, Inc., at Wheeling, W. Va.

Other top national officers elected, for terms which started October 1, include G. Franklin Dean, supervising engineer of lighting service, Toronto Hydro-Electric System, Toronto, vice-president for a two-year term; J. Dixon Mitchell, region engineer, Southeast region, lamp division, Westinghouse Electric Corp., Chamblee, Ga., general secretary; and William P. Lowell, Jr., manager of technical liaison and quality control departments, Sylvania Lighting Products, Inc., Salem, Mass., re-elected treasurer.

James R. Chambers, sales manager, lighting products division, Appleton Electric Manufacturing Co., Chicago, Ill., continues as the society's vice-president for the second year of his two-year term.

New regional vice-presidents, and the areas they will serve are as follows:

Alston Rodgers, illuminating engineer and lighting education specialist, General Electric Lighting Institute, Cleveland, Great Lakes region.

Richard D. Cohen, lighting sales manager, Glasco Electric Co., St. Louis, Midwest region.

John Sharp Williams, IV, manager of technical operation and field assistance, Arkansas Power & Light Co., Little Rock, Ark., South Central region.

Roy H. Kreyser, illuminating engineer, department of water and power, City of Los Angeles, South Pacific Coast region.

Jack T. Cottingham, manager commercial sales, Portland General Electric Co., Portland, Ore., Pacific Northwest region.

Richard M. Smart, regional engineer, lighting products division of Sylvania Electric Products, Inc., Melrose Park, Ill., North Central region.

Robert L. Zahour, manager of lamp applications, Westinghouse lamp division of Westinghouse Electric Corp., Bloomfield, N. J., Northeast region.

Switch exhibit set for national tour

THE BARKELEW ELECTRIC Manufacturing Company's new traveling switch exhibit is headed for the turnpikes and the freeways of the nation. It features Barkelew's revolutionary new product, the Bolt-Loc pressure contact switch.

Behind the wheel of the mobile exhibit is Charles W. (Jack) Wright, sales engineer of the Middletown, Ohio, firm which has been making switches for the past half-century.

Mr. Wright, in his coast-to-coast tour, will introduce the compact Bolt-Loc load break service entrance switch to Barkelew customers, public utility companies, steel mills, chemical plants, consulting engineers, architects, and electrical equipment distributors.

Barkelew's Bolt-Loc pressure contact switch is examined by Charles W. Wright, Barkelew sales engineer, and Lester G. Stimson, who redesigned the truck for the planned coast-to-coast switch exhibit.

The display-on-wheels is housed in a Volkswagen truck specially redesigned by Lester G. Stimson of the Barkelew staff. The Bolt-Loc switch is installed on one side of the truck and the regular Barkelew switches are mounted on a swivel panel on the other side of the truck. In the rear are files for technical literature and records.

Bolt-Loc, which has ingenious safety and operating features, combines maximum current-carrying and load-interrupting features with a modern, compact, rugged, and easily mounted design.

It can be furnished in 1200 through 4000 ampere capacities for 240, 480, and 600 volt service. Two, three, and four-pole switches are available fused or unfused, for front and rear connections.

With the Bolt-Loc system, the pressure mechanism firmly bolts the blades to the contacts when the handle is moved to the closed position.

When the handle lever is moved far enough, a quick-break mechanism opens the blade. The handle lever provides positive opening and closing.

Exclusive double-slot arc quenchers draw the arc from the arcing tips that divides, cools, and extinguishes it. The replaceable arcing tips' action in interrupting the arc prevents pitting or burning of the main current carrying contacts.

Electric heat equipment: seven per cent of total

A RECENT SURVEY by the U. S. Department of Commerce shows that in 1959 annual shipments of electric heating equipment amounted to seven per cent of the national total of heat producing equipment.

Of the manufacturers contacted, 13 stated that they did not manufacture electric heating equipment in 1959 but that production was contemplated in 1960 or soon thereafter.

Shipment by types and per cent of total dollar value of electric heating equipment are as follows: baseboard, 29.9; convectors, 35.4; glass panels, 7.5; unit heaters and unit ventilators, 20.3; warm air furnaces, 1.3; and cable systems, 5.6. Total value was $27,834,294.

Westinghouse expands Electric Home program

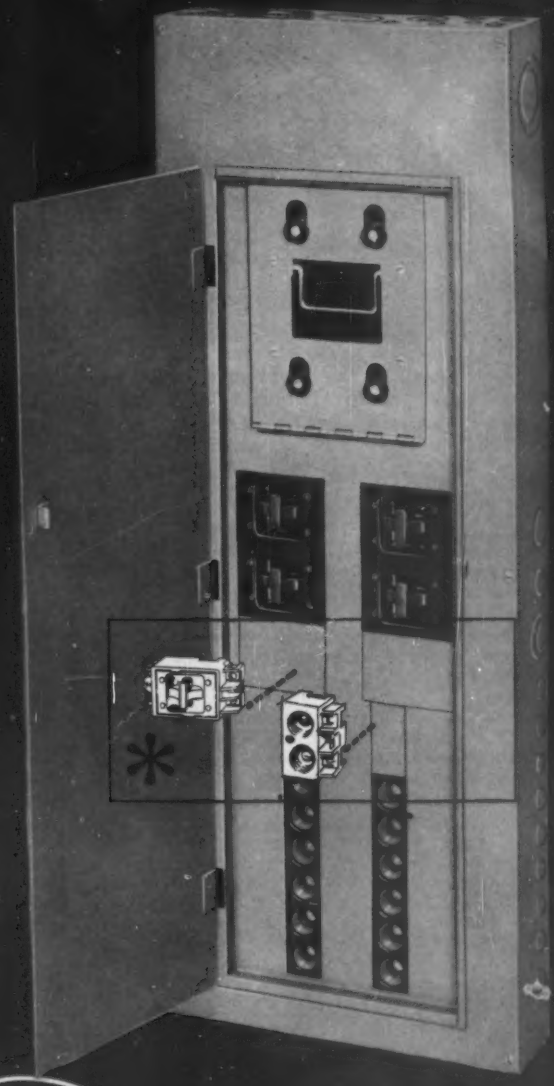
EXPANSION OF its Total Electric Home program into a newly formed organization, to be designated the residential marketing department, has been announced by the Westinghouse Electric Corp.

At the same time, Chris J. Witting, vice-president, consumer products, said William H. Loeber, former Total Electric Home marketing manager, has been named manager, residential marketing department. He will report to Mr. Witting and will be headquartered at the company's offices in New York City.

"It has been apparent to us," said Mr. Witting, "since we began the Total Electric Home program 18 months ago, that builders are more interested today in buying as many services and products as possible from one supplier as a step toward reducing their administrative costs and the ultimate cost to the consumer."

NEW!

200-AMP ADD-ON* SERVICE Equipment



HINGED MAIN PULLOUT!

ARROW AH HART

FLEXIBLE and VERSATILE... All 200-amp "Add-On" pullout and branch circuit units are interchangeable with A-H 100-amp "Add-On" units. Now you meet any customer's 200 amp electrical needs—present *or* future—with just one unit. This unit comes factory-assembled with a main 200-amp pullout, four 30- or 60-amp pullouts and twelve fused branch circuits . . . and you can add 1 or 2 pullouts and 2 or 4 branch circuits at any time with a maximum of 6 pullouts and 16 branch circuits. Exclusive hinged main pullout for convenience.

COMPACT ENCLOSURES... smaller than other comparable units, save space and make faster installations. The 14⅜″ width allows mounting between studs.

FAST, EASY INSTALLATION... is insured by extra wiring space throughout the enclosure . . . including full 5″ head space for incoming service lines. Ample knockouts are located adjacent to the branch circuits. Neutral terminal bars will accept wire sizes 4 to 14.

GET ALL THE FACTS. Write today for complete information. Department ES. The Arrow-Hart & Hegeman Electric Company, 103 Hawthorn St., Hartford 6, Conn.

STOCK AVAILABLE FROM OUR ATLANTA WAREHOUSE

ARROW AH HART

Quality since 1890

ENCLOSED SWITCHES • WIRING DEVICES
MOTOR CONTROLS • APPLIANCE SWITCHES

Shown here is the architect's rendering of the ultra-modern 175,000 square foot facility which is being built just northwest of Chicago in Des Plaines, Ill., for Federal Pacific Electric Co.

Included in the Westinghouse product line are heating and cooling equipment, wiring devices, meters, appliances, television and radio, lighting, and Micarta counter tops or wall paneling. In the case of apartment projects, electrical switchgear and elevator installations are available.

As an indication of the trend towards electrical living, the Westinghouse executive pointed out that 18 months ago there was only a handful of utilities interested in promoting electric living.

"Today we have active programs under way with 85 of the nation's leading utilities and with some 160 tract builders from coast to coast," he said.

Brief news notes of manufacturers

FEDERAL PACIFIC Electric Company has broken ground for a 175,000 sq. ft. building near the O'Hare International Airport, northwest of Chicago, it was announced recently by Frank H. Roby, executive vice-president of the electrical equipment and electronic components manufacturing firm.

When completed early in 1961, the ultra-modern plant is to contain four company operations—Federal Pacific's regional sales office and midwestern redistribution warehouse, Cornell-Dubilier's area sales office and central redistribution warehouse, Economy Fuse manufacturing operations now being conducted in Chicago and Palatine, Ill., and the Economy Screw Corp., which manufactures screws and other fasteners for Federal Pacific plants and other original equipment manufacturers.

* * *

EAST COAST RADIO of Orlando Inc., Orlando, Fla., recently has been named an authorized industrial distributor for the Electronic Distributor Division of Ward Leonard Electric Co., Mount Vernon, N. Y. The Orlando outlet of East Coast Radio will handle Ward Leonard's complete line of Vitrohm wire-wound power resistors, Vitrohm ring type rheostats and industrial relays.

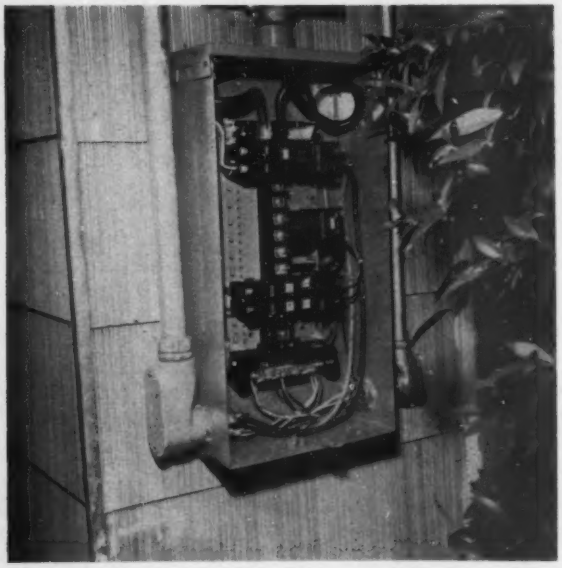
Family gets awards for first Stab-lok

THE FAMILY of Harold E. Farley, 2885 Montague Ave., Memphis, Tenn., will probably never be the same.

Mr. Farley, a Memphis bus driver, didn't know until recently that he had in his home the first Stab-lok circuit breaker ever installed in the United States—the first of 75 million that have now been produced.

The historic event which placed this original Stab-lok breaker in the Farley home occurred ten years ago. It was then that Federal Pacific Electric Company introduced to the nation its line of Stab-lok circuit breakers which were to revolutionize the home wiring market, much as the Ford car did to automobiles, and the Singer sewing machine did to sewing.

Robert Sleesman, Federal Pacific marketing manager in charge of Stab-lok, is showing the 75 millionth Stab-lok to Mr. and Mrs. Farley. In the background is the original Stab-lok circuit breaker.



The new 150-ampere service entrance equipment installed in the Farley home replaces the original 40-ampere service installed ten years ago. Rewiring was given to the Farleys by Federal Pacific.

To commemorate the occasion, Federal Pacific planned a few surprises for the Farleys, in cooperation with Memphis' Orgill Bros. & Co., the Southern electrical distributors who sold this first Stab-lok breaker, and Electric Wiring Co., the Memphis electrical contracting firm who installed it.

The first surprise on the agenda was the arrival by air from Newark of the 75 millionth Stab-lok breaker which a Federal Pacific representative installed in the Farley electrical service entrance enclosure in place of the original Stab-lok breaker.

Second, the Farleys received as a gift from the three companies a completely rewired electrical service, which will enable them to take advantage of any and all electrical appliances that have become popular in the ten years since their home was originally wired.

Third, the Farleys, in a ceremony attended by leading Memphis officials as well as representatives from Orgill Bros. & Co., Electric Wiring Co., and Federal Pacific, were presented with an electric range and air conditioner so they could start immediately to enjoy the pleasures of modern electrical living.

Fourth, at a banquet held for the family, Mr. Farley was presented with ten shares of Federal Pacific stock. "We want the Farleys to be part of our Federal Pacific family," said Frank H. Roby, the company's executive vice-president, "just like Orgill Bros. & Company is part of our distributor team and Electric Wiring Company is part of our contractor team."

Federal Pacific plans to apply for a $1,000,000 insurance policy with Lloyd's of London and then display the first Stab-lok breaker around the nation in a special exhibit.

Dates ahead

Southeastern Electric Exchange, Sales Conference, Henry Grady Hotel, Atlanta, Ga., Nov. 16-18, 1960.

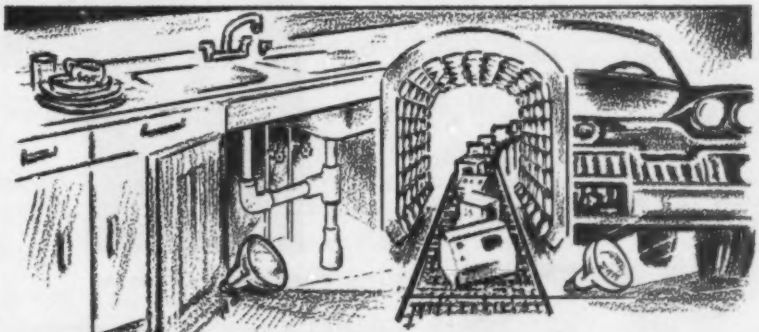
Missouri Valley Electric Assn., Industrial and Commercial Sales Conference, President Hotel, Kansas City, Mo., Feb. 9-10, 1961.

Missouri Valley Electric Assn., Engineering Conference, President Hotel and Municipal Auditorium, Kansas City, Mo., April 12-14, 1961.

Alabama Electrical and Electronics Exposition, Second Annual Exposition, Birmingham City Auditorium Convention Hall, Birmingham, Ala., April 17-19, 1961.

The eyes of insects are less attracted to yellow light than white light — a fact which makes yellow "bug" lamps desirable illumination for outdoor living.

Incandescent lamps made for outdoor use are protected from rain, snow, heat, and cold by glass which can withstand abrupt temperature changes — similar to the glass used in household baking dishes.



Light THAT'S NOT MEANT TO BE SEEN

Infrared heat and drying lamps are used for heat not light; to thaw frozen pipes, dry clothes, warm cold motors, quick dry film, dry paint, etc.

THERE ARE OVER 3,000 types OF CHAMPION LAMPS FOR INDUSTRIAL AND COMMERCIAL USE

CHAMPION LAMP WORKS, Lynn, Massachusetts

CHAMPION INCANDESCENT-FLUORESCENT • *YOUR BEST BUY IN LAMPS*

News about people

The James R. Kearney Corp., St. Louis, Mo., has announced the appointment of **Robert E. Deal** as general sales manager. Mr. Deal was formerly manager of marketing with the 3E Company which has recently been acquired by Kearney. In his new position, Mr. Deal will be responsible for co-ordinating sales of the 3E line of switchgear and ap-

Robert E. Deal

paratus and the more diversified Kearney line of utility equipment.

Mr. Deal is an electrical engineering graduate of the University of Tennessee. His extensive background in the electrical apparatus field includes five years with Line Materials Industries and six years with the Duke Power Co., of Charlotte, N. C.

The appointment of **Jack Steinhauser** as district manager of the James R. Kearney Corporation's Texas and New Mexico sales terri-

Jack Steinhauser

tories has been recently announced by the company. Mr. Steinhauser succeeds **E. C. "Red" Dwelle,** who is retiring.

Mr. Steinhauser served as assistant to Mr. Dwelle in the Texas and New Mexico areas prior to his new appointment.

Mr. Dwelle is retiring after 33 years of service with the Kearney corporation.

Wesley J. Gorder has assumed the position of manager of sales and engineering at the newly acquired Alrectic Division of McGraw-Edison Company in Jackson, Mich. The Alrectic Division was formerly the aluminum fabricating portion of the Handley-Brown Co.

For 12 years, Mr. Gorder has been active in the substation field. The past seven years were in the employ of another McGraw-Edison division where he headed up the substation sales and engineering force. Mr. Gorder graduated from the University of Wisconsin with a B.S. degree in electrical engineering.

Gerald F. Heagney has been appointed advertising and sales promotion manager of the Thomas & Betts Co., 36 Butler St., Elizabeth, N. J.

Gerald F. Heagney

Mr. Heagney joins the electrical manufacturing firm after an affiliation with Westinghouse Electric Corporation as advertising manager of the X-ray and Industrial Electronics Div., Baltimore, Md. He was graduated from Boston University in 1951 with a B. S. Degree in Public Relations.

Motorola has named **Robert H. Davis** as chief engineer of its Microwave Dept. In this capacity, he is responsible for microwave product development, systems engineering and field engineering. Mr. Davis has been associated with the Microwave Department since graduating from the University of Minnesota in 1950. He served as a field project engineer for four years, then was appointed manager of microwave systems engineering in 1954. In 1958 he assumed the additional responsibilities of microwave publications.

The promotion of a veteran of 35 years of Arkansas Power & Light Company service to the position of general sales manager was announced recently by AP&L Vice-President **W. M. Shepherd.** Named to the position is **Edward G. Barry** who has served the past 10 years as

Edward G. Barry

commercial sales manager in the power company's General Office Sales and Development Dept., headquartered in Little Rock.

Mr. Barry will have charge of the power company's sales and promotion activities under the direction of Vice-President Shepherd. He began his electric company career with the utility system serving Hot Springs, beginning in 1925. He advanced through the positions of power salesman, division sales manager and manager of the company's operations at Arkadelphia before being named commercial sales manager in 1950.

Edward H. Lewis, 63, president and founder of Western Insulated Wire Co., Los Angeles, died suddenly of a heart attack in his Brentwood, Calif., home October 4.

Mr. Lewis was born August 28, 1897, in New York City. He graduated with a degree in mechanical engineering in 1921 from Cornell University. For 12 years he was associated with the General Electric Co., in Schenectady, N. Y., and Bridgeport, Conn. In the two following years he served as general manager of the Hatfield Wire and Cable Co., Newark, N. J. In 1937 Mr. Lewis founded Western Insulated Wire Co.

Robert J. Guidera has been appointed product sales engineer for the Hickory, N. C., plant of General Electric's distribution transformer department. Mr. Guidera's appointment was announced by **J. J. Farrell,** department southern regional sales manager.

Mr. Guidera will replace Mr. Farrell in the sales engineer position.

Mr. Guidera is a graduate of the United States Military Academy. He joined the test program of General Electric in 1954. In November, 1959, he was named distribution equipment sales engineer, a position he held until his present assignment.

STOP PROFIT KNOCKOUT...

with the

Carol

Protected-Profits Inventory Control Plan

When business is good—*but* your profits are taking it on the chin—just look at your inventory! Dead stock on your shelves—items that are obsolete or too slow-moving—knocks out profits every time.

Profits start with *buying*—the *right* merchandise . . . at the *right* price . . . in the *right* quantity . . . and with the *right* service and cooperation to insure rapid turnover.

That's why it'll pay you to know about the **Carol Protected-Profits Inventory Control Plan** . . . a newly developed service designed to:

- **Insure maximum turnover**
- **Eliminate obsolescence**
- **Insure adequate inventory to fill all orders promptly**
- **Insure balanced inventories**
- **Protect your profits**

STOP TAKING IT ON THE CHIN . . . Ask your Carol salesman for full details on the "Carol Protected-Profits Inventory Control Plan"—or write, wire or phone Carol Cable Company, Pawtucket, Rhode Island.

When you call for cable—call for Carol!

Portable Cords • Power Supply Cable, Types W & G • Arc Welding Cables • Cord Sets • Asbestos Types • Plastic Jacketed Cords • Thermostat Wires • And Many Others

CAROL CABLE COMPANY

Division of the Crescent Company, Inc., Pawtucket, R.I.

The election of two new vice-presidents has been announced by Florida Power Corporation president **W. J. Clapp. M. F. Bunnell** was

M. F. Bunnell

A. P. Perez

named vice-president in charge of industrial relations, and **A. P. Perez** a vice-president in operations.

Appointment of **George "Bud" McMahon, Jr.,** as Petersen Engineering Co.'s sales and service representative for the South Central states was announced by **Gerald A. Petersen,** president of the Santa Clara, California, firm.

As field representative, Mr. McMahon will handle sales and service on the complete PENGO line of earth augers, tension stringing equipment and line construction accessories. For the past few years he has held the position of field engineer with a major line materials firm.

Five recent transfers have been made among the personnel of the Square D. Co., Atlanta, Ga., according to **S. T. Walz,** region manager.

R. W. Fuller, formerly district manager in Richmond, Va., was transferred to Charlotte to replace **L. J. Murrans** as district manager of the Charlotte district.

M. M. Smith, who was serving as Jacksonville manager, has been transferred to Richmond to replace R. W. Fuller as manager of the Richmond office.

R. A. Mingus was transferred to Birmingham as district manager, where he also has jurisdiction over the Pensacola office. He replaces **Murray Graham,** who was transferred from Birmingham to Jacksonville to assume authority over the recently created Jacksonville-Orlando district.

M. S. Siepak was transferred from supervisor of Atlanta headquarters sales to Pensacola as manager of that office.

H. E. Cole, Jr., has been named district manager of the Atlanta District, National Electric Division, H. K. Porter Co., Inc., which consists of six branches located in the cities of Birmingham, Alabama; Charlotte, North Carolina; Miami, Florida; New Orleans, Louisiana; Richmond, Virginia; and Tampa, Florida. Mr. Cole was formerly Branch Manager of the Charlotte Branch which included the states of North and South Carolina.

Mr. Cole joined National Electric in 1945 as a sales engineer in the Charlotte Branch.

J. B. Cottell, president of Continental Electric Equipment Co., 205 W. Fourth St., Cincinnati, has announced the appointment of **John A. Conners** as assistant sales manager.

Mr. Conners is a graduate of the University of Cincinnati and a member of the Engineering Society of Cincinnati and the Cincinnati Electrical Association. He will be responsible for coordinating the Commercial and Government sales programs, directing advertising, and supervision of the internal sales staff at the home office.

The appointment of **Thomas E. Sherman** to the newly-created post of sales engineer serving as staff assistant to the manager of sales, power industry products, Preformed Line Products Co., 5349 St. Clair Ave.,

Thomas E. Sherman

Cleveland, Ohio, was announced by **Edmund H. Brown,** vice-president-sales. Mr. Sherman's technical training was acquired at the University of California and Pacific Gas & Electric Co.

P. W. O'Malley, vice-president and general manager for the Wire and Cable Division, Essex Wire Corp., has announced the appointment of **J. W. Mitchell** as Paranite Products sales manager.

Mr. Mitchell has been active in various sales capacities in Paranite for the past ten years. His headquarters will be in the General Offices located at 2601 South Adams Street, Marion, Ind.

Jay M. Witbeck of Charlotte has been appointed manager of the Charlotte region of Crouse-Hinds Co., according to **A. F. Uhrlandt,** director, field sales.

Crouse-Hinds manufactures cast electrical conduit fittings, electrical

Jay M. Witbeck

equipment for hazardous locations, plugs and receptacles, airport lighting products, floodlights, and traffic control systems.

Randall S. Stevens has been appointed advertising manager of Edwards Company, Inc., one of the nation's oldest and largest producers of electrical and electronic control, communications, and protection equipment, according to **R. L. Kempton,** marketing vice-president.

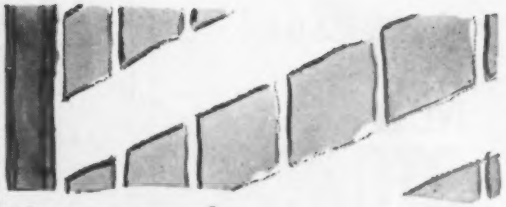
In his new assignment, Mr. Stevens will guide the 88-year-old firm's advertising and public relations activities. In addition, he will be responsible for the company's catalog, direct mail, packaging, and exhibits program.

The Fisher-Pierce Company has appointed **Edward V. Diercks** as a sales application engineer. He will work primarily with utility and OEM products of the South Braintree, Mass., firm, a field in which he has had ten years of experience. Mr. Diercks is a graduate of Cornell University.

Strengthening of its southeastern sales, service, and promotional activities has been effected by Progress Manufacturing Co., Philadelphia, Pa.

Will Turner, vice-president marketing, has announced the appointments of **Charles F. Sibley** as Progress representative for eastern Tennessee, Alabama, and the Pensacola, Fla., area, and of **LeRoy Stark** as Progress representative for southern Florida.

"You put on a Payroll Savings Campaign last year...



How many of your employees are still using the plan—every month?"

"Practically ALL of those who signed up are still buying U. S. Savings Bonds every month. We talked to many of them about it, and they told us that the Payroll Plan got them started on their first regular savings program. 'We just couldn't seem to save by ourselves,' they told us. 'This way, we don't even miss the deduction.' Gives us a nice feeling to find out we're helping them to help themselves."

If your company has not installed the Payroll Savings Plan thus far, you, too, may be surprised to find how great a number of your people will welcome this convenient way to start saving. The Plan is simplicity itself to put in. Just contact your State Savings Bonds Director and have him show you just how the Plan works. Let him help you set up a thorough canvass of your company family, so that every employee may be invited to share in this easy way to become a shareholder in America. Experience in other fine companies shows that such an invitation usually results in an enthusiastic response.

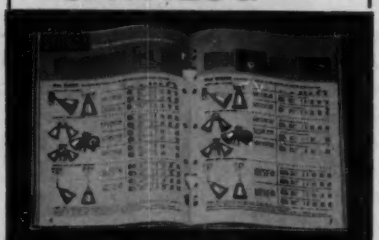
ALL U.S. SAVINGS BONDS—OLD OR NEW—EARN ½% MORE THAN BEFORE

ELECTRICAL SOUTH

THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE.

just issued...

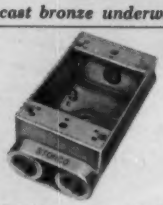
NEW STONCO CONTRACTOR CATALOG



32 page catalog helps you select, price, order the exact fixtures you require . . . faster, easier.

NEW *low cost mercury floodlights*

NEW *cast bronze underwater lights*



NEW *FS boxes for all covers*

NEW *decorative outdoor bullets*

WRITE FOR CATALOG TP-2

STONCO ELECTRIC PRODUCTS CO.

333 MONROE AVE., KENILWORTH, N. J.

Technical books

for the electrical man

Analog computers

"Analog Computation in Engineering Design," by A. E. Rogers, Electronic Associates, Inc., and T. W. Connely, Marine Div., Sperry Gyroscope Co. Published by McGraw-Hill Book Co., Inc., 327 West 41st St., New York 36, N. Y.; 450 pages, 275 illustrations; $16.00.

Practical techniques for using analog computers to solve problems in engineering design are presented in this newly published book. It stresses methods of problem preparation, shows how to effectively use computers, and gives illustrative examples of computer techniques used to solve technical problems in such areas as chemical processes and process controls, feed-back control systems, nuclear reactors, and problems involving statistical phenomena.

The book gives specific computing techniques for solving partial differential equations and algebraic problems, as well as information on the use of the adjoint technique and statistical methods in investigating linear systems.

Included in this reference is a thorough treatment of the problem preparation procedure. In addition, the book provides a concise review of pertinent topics from engineering mathematics.

Planned as a useful, day-to-day reference, the book provides engineers and others who have a problem to solve by simulation on a computer with the practical help they need to facilitate their work and insure most effective application of computer techniques.

Estimating manhours

"Estimator's General Construction Manhour Manual," by John S. Page. Published by the Gulf Publishing Co., P. O. Box 2608, Houston 1, Texas; $10.00.

Here is a manual that gives the reader an accurate and convenient method of estimating direct labor for complete general construction work in any given system, plant, or location.

The scores of manhour tables in this manual contain thousands of easy-to-use listings which are valuable guides to estimating manhours in every phase of general construction work.

The manual points out how to arrive at composite rate using productivity efficiency and production elements. With the composite rate, manhour estimating can be applied to any general construction job.

Subject areas covered in 17 sections include: demolition; site-grading and structural excavation; concrete roadways; sheet and steel and mesh; miscellaneous embedded items; concrete; masonry; structural steel and miscellaneous items, carpentry and millwork; metal doors; sash glass and ceilings; roofing and siding; ornamental metal and special partition; painting.

Vacuum tubes

"Getting the Most out of Vacuum Tubes," by Robert B. Tomer. Published by Howard W. Sams and Co., Inc., 2201 East 46th St., Indianapolis 6, Ind.; 160 pages, $3.50.

The book shows how, through proper maintenance, premature tube failures can be prevented. It points out those engineering practices leading to premature tube failures, and those maintenance practices contributing to additional failures. Extensive records, covering thousands of tubes in all types of electronic apparatus all over the world, back up this statement, according to the author.

Written for technicians, engineers, and designers, the book covers a wide range of subjects, including catastrophic, degenerative, and subjective failures; characteristic variables; selected and premium tubes; tube types, performances, testing, and special purposes; methods of lengthening tube life; ionization, deionization, and waiting times; and maintenance procedures.

Tube substituting

"Tube Substitution Handbook," by the engineering and technical editing staffs of the Howard W. Sams Publishing Co. Published by Howard W. Sams and Co., Inc., 1720 East 38th St., Indianapolis 6, Ind.; 96 pages; $1.50.

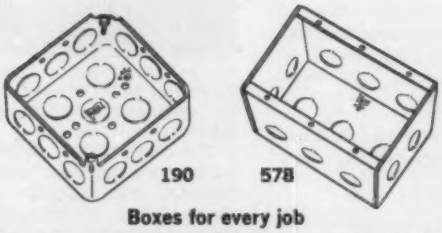
This book is one of the most complete and authoritative reference books on direct tube substitutions published to date — including over 3,800 total substitutions.

In the directory of over 1,500 American receiving tubes alone, 2,048 substitutions are listed. In addition, two other sections list 169 industrial and 489 European additional substitutes for American receiving tubes. Still another section recommends 301 American substitutes for European types. Also included is a directory of 400 picture tubes, with recommendations for 799 substitutions.

The book is invaluable for the service technician who daily faces a maze of different tube types.

Fittings for every need

from one reliable source...RACO



Boxes for every job

Raco boxes offer you more dollar-saving installation benefits than any other. It's the longest line, too.

No matter what you need fittings for, you can avoid problems by specifying Raco. You'll find threads are deep and true. Set screws are in place and turn easily. Finishes are bright and clean.

From the largest service entrance fitting to the smallest, you'll find the right fitting at Raco.

Most versatile and complete line of roughing-in materials.

RACO

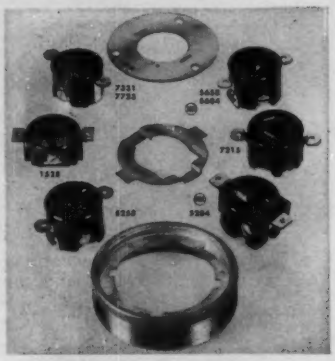
ALL-STEEL EQUIPMENT INC.

Aurora, Illinois

This "K E Y" Fits
Most Popular
RECEPTACLES
Found at Your
DISTRIBUTORS

This "KEY" which has been added to our #190 series—*at no extra cost*—was designed to fit most popular size and style receptacles.

The "KEY" drops easily into special slots in adjusting ring—you select the receptacle required and simply "LAY-IN"; then "LAY-ON" receptacle ring. That's all—no more ears to clip—very easy to install.



FULLMAN'S
Adjustable
STEEL BOX
190-N R Series
No Receptacle

Our #190 series is a standard 4" octagon, sheet steel box and takes ½" up thru 2 3/8" abandon plug. Box-body opening is plenty large for complete hand access from top of concrete to bottom of box.

A second tin lid is provided for pouring concrete to very top.

Sold Only Thru Wholesalers

Fullman
MANUFACTURING
COMPANY
1209-1215 JEFFERSON ST.
LATROBE, PENNSYLVANIA

New products

Arrow hollow-wall anchor

The new Dazy hollow-wall anchor has been added to the broad line of fastening and drilling devices for masonry of Arrow Expansion Bolt Co., Marion, Ohio. The Dazy is a sturdy, easy-to-use fastener that requires a small hole for securing fixtures to wallboard, plasterboard, lath and plaster, tile plywood, sheet metal, etc.

It is made in nine sizes to accommodate various wall thicknesses and loads. When installed, the fixture can be removed and replaced as many times as necessary without disturbing the anchor.

A unique rib-design on the underside of the screwhead eliminates galling in installation. On jobs requiring many Dazy anchors, the work can be further simplified by using a Yankee screwdriver.

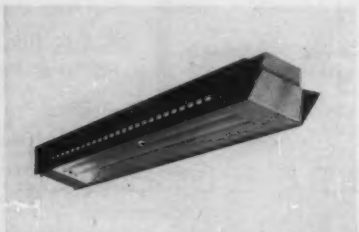
Arro products are marketed nationally through industrial, hardware, and electrical distributors.

Write in No. P-1118 on card, pg. 17

Fostoria infrared heater

A new line of electric infrared comfort heaters for creating comfort conditions in hard-to-heat indoor or outdoor areas has been introduced by Fostoria Corp., 1200 N. Main St., Fostoria, Ohio.

Since the new infrared heaters transfer radiant energy directly from source to object without costly heating of the intervening air, they are ideal for outdoor heating, for indoor areas where large air movements make conventional space heating costly or ineffective, for areas where only occasional heating is required, or for localized heating.



They are also extremely practical for supplemental heating since they can be easily and economically installed without disturbing walls, floors, or expensive modification of existing heating plants. Designed for overhead mounting, they can be installed as easily and quickly as lighting fixtures.

Known as series CH, they are available in various models for use with linear quartz tubes manufactured by Fostoria or with standard high temperature T-3 linear quartz lamps which provide extremely high operating efficiencies converting as much as 86 per cent of electrical energy into radiant output.

Write in No. P-1119 on card, pg. 17

Chalfant cable truss

The need for a lower cost power cable, control cable, instrument tubing, process tubing, and piping support system is being met with the new series six cable truss manufactured and sold by the Chalfant Products Co., Inc., 11525 Madison Ave., Cleveland 2, Ohio.

Although Chalfant engineers have brought the cost down, they have not sacrificed the quality, strength, rigidity, and versatility demanded by engineers, contractors, and installers.

The new truss is available in widths of six, nine, 12, and 18 inches. Smooth, rounded-edge louvers are stamped into the bottoms of the truss throughout the entire length. The louvers are 3⅛" wide with lengths in proportion to the width of the tray. Louvers are evenly spaced 1¾" apart throughout the entire length of the cable truss.

The louvers provide additional strength to the truss as well as ventilation for the cables, after installation is made. Cables may be

easily and conveniently dropped out through these louvers, anywhere along the truss. Complete protection is accomplished because there are no sharp edges to cut or damage the cable. Since there is no need to cut openings in the truss for dropouts, installation time is saved.

This truss is available in aluminized steel, aluminum, and galvanized steel.

Write in No. P-1120 on card, pg. 17

Sun-Tron ceiling heater

A new electric ceiling heater that can be used in new construction for kitchens and bathrooms, or in existing construction for supplementary heat in any room, is being introduced by Sun-Tron Corp., 7435 W. Wilson Ave., Chicago 31, Ill.

The unit is not recessed, but mounts directly on the surface of the ceiling. Its depth is only 2¾ inches.

The electric panel has no moving parts. It is different from most other models on the market in that it pro-

vides both radiant heat and air circulation by natural means.

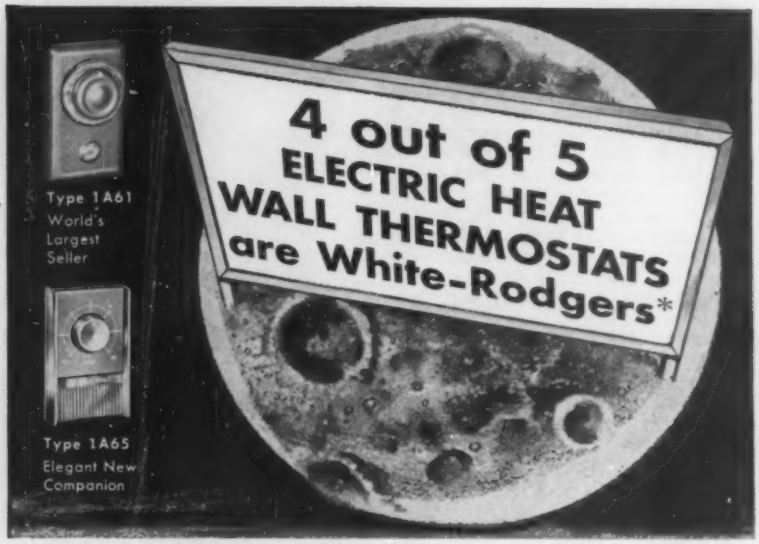
Cross-angle radiation, which beams heat at angles into every corner of the room, is provided by a scientifically designed perforated steel face panel. Air circulation is provided by vents on either side of the unit which admit air. The air is heated and circulated across the ceiling. When it reaches the outer walls, it falls naturally as it is cooled, and then recirculates back into the heater.

Write in No. P-1121 on card, pg. 17

Westinghouse bulb packaging

A fresh approach to household light bulb packaging has been undertaken by Westinghouse Electric Corp., Lamp Div., MacArthur Ave., Bloomfield, N. J.

The new packaging embraces a bold color concept employing a different hue for each wattage, completely redesigned graphics including the prominent use of a new corporate trademark, and new outer wrappers



Everywhere . . . people prefer White-Rodgers electric heat wall thermostats—universally famous for styling, easy installation and years of trouble-free performance.

** Sold under the brand names of more than 50 manufacturers.*

WHITE-RODGERS CO.

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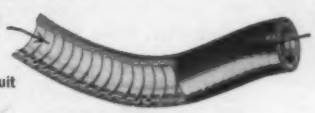
VULNERABLE CIRCUITS NEED

LIQUATITE®

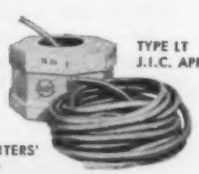
FLEXIBLE CONDUIT PROTECTION



Liquatite insures against costly down time due to wiring failure. It protects against contamination, vibration, motion and shock; proves ideal for "wet locations," around corrosives or where severe punishment may cause shorts or burn-outs.

Added to this, Liquatite installs as easily as Flexible Conduit—follows contours, takes small radius bends necessary for hard-to-get-at locations.

Write today for free sample, costs and name of Distributor nearest you.



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ELECTRI-FLEX COMPANY

P. O. BOX 128-N ROSELLE, ILLINOIS

made of paper almost twice as heavy as that used previously.

The new packaging, to be used on the company's standard line of inside frosted light bulbs, was created by one of the country's foremost graphic designers, Paul Rand. Mr. Rand has designed the trademarks and graphics for a number of the nation's leading concerns.

Employing extreme simplicity of design on a clean white background, the large sides of the new package contain only four words and three figures.

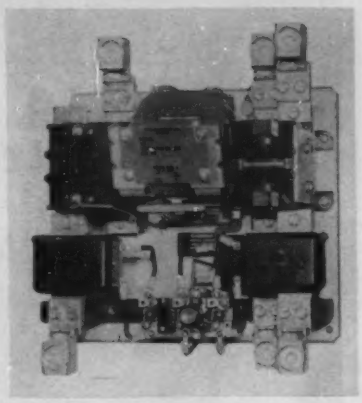
Write in No. P-1122 on card, pg. 17

Compact magnetic starter

Cutler-Hammer, 315 N. 12th St., Milwaukee, Wis., has introduced a compact Size 5 starter in an extension of its 3-star line of magnetic starters, already available in Sizes 00 through 4.

Representing the smallest Size 5 currently offered by a major manufacturer, maximum dimensions of the Cutler-Hammer device are: width, 13 inches; height 15 3/16 inches; and an especially shallow depth, 6 1/8 inches. The C-H Size 5 can be mounted in an enclosure only 8 inches deep.

The unique contact structure of Cutler-Hammer's Size 5 minimizes



bounce, heating, and wear. Parallel double-break contacts provide four contact points to easily accommodate the heavy current surges associated with Size 5 applications. For accurate overload protection, epoxy-cast current transformers and low current overload relays are used.

Write in No. P-1123 on card, pg. 17

Bryant white wiring devices

A line of pure white wiring devices to meet the growing needs of designers and decorators has been introduced by the Bryant Electric Co., Bridgeport 2, Conn.

The line includes conventional wall switches, outlets, and a variety of wall plates. Bryant's Fashion Plate wall switch, a buttonless switch that mounts flush against the wall, is also available in white.

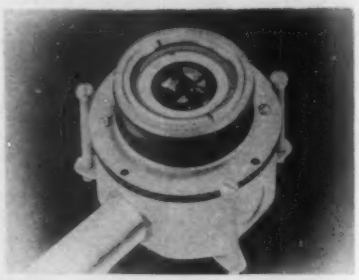
In addition to matching the trend toward greater use of white walls, the white devices provide a more pleasing contrast to other wall colors than the traditional brown and ivory wiring devices. Prices on the new line will be the same as ivory devices.

Write in No. P-1124 on card, pg. 17

Porter 600 series floor box

An improved 1961 Model "800" series floor box has been introduced by National Electric Div., H. K. Porter Co., Inc., Porter Bldg., Pittsburgh, Pa.

In addition to all the advantages offered in the original "800" floor box many extra features have been added to provide complete flexibility. The floor box is used to provide a



convenient power source for office machines, lighting, and communications equipment.

Some of the features of the new floor box include ability to accommodate the widest range of receptacles, including two-wire and three-wire; NEMA grounded, T-slot; and twist-lock types through 20-ampere capacity. It also has a larger hand-hole for ease of fishing conductors, and a redesigned mounting ring that facilitates easy field installation of intercom, microphone, and telephone receptacles. A new floor plate will now accept ½-inch, ¾-inch through 1-inch conduit.

Write in No. P-1125 on card, pg. 17

Keystone fluorescent fixture

Keystone Electric Manufacturing Co., 2228 East Tioga St., Philadelphia 34, Pa., has introduced the Regal, a new two-, three-, or four-lamp fluorescent fixture with prismatic lens. Any of these lamp arrangements is available in both four- and eight-foot lengths.

Although shallow in appearance, sufficient width and depth have been allowed in the design of this lumi-

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Authentic, Time Saving—Easy to Use

This book is easy to use—it has no complicated mathematics or formulas to work over. You merely determine the nature of the wiring, check it in the BLUE BOOK OF ELECTRICAL ESTIMATING and there's your answer—it's the simplest estimating book ever written.

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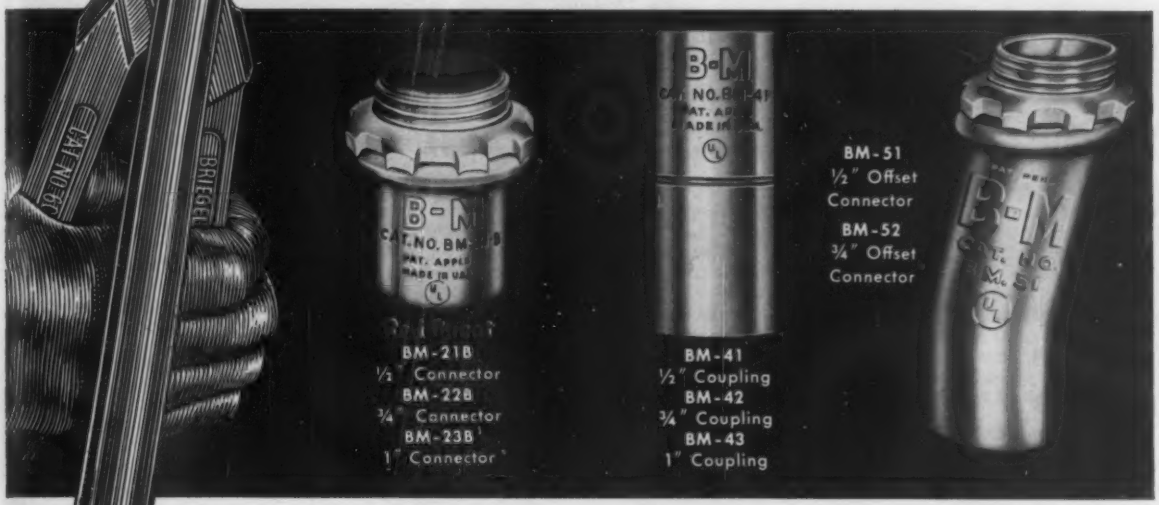
It's a Breeze!

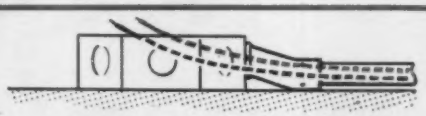
Just a *Double Squeeze*

Sets Up E. M. T.

With Original B-M Indenter Fittings

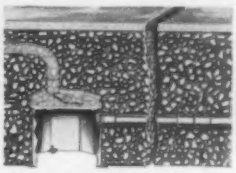


● B-M Indenter Fittings and Tools make an unbeatable combination when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws. Other plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



B-M Offset Connector, showing how wires are guided over box edge.

Briegel All Steel Indenter Fittings are U.L. approved as Concrete-Tight.



BRIEGEL METHOD TOOL CO.

GALVA, ILLINOIS

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

USED THE MOST FROM COAST TO COAST

naire so that the possibility of hot spots has been eliminated.

Produced in Keystone's Achro-Lens, the Regal's wraparound shielding is said to be stronger than ordinary prismatic due to its inverted prism construction. This diffuser is self-centering.

Featured also are snap covers which require no tools or fasteners.

Write in No. P-1126 on card, pg. 17

Wheatland plastic conduits

Two new lines of rigid plastic electrical conduits are available from Wheatland Electric Products Co., 500 Logan Street, Carnegie, Pa.

Wheatland Electric rigid PVC polyvinyl chloride plastic conduit, designed for both above- and underground installations, is available in two types. Type A light wall and type 40 heavy wall plastic conduits are gray in color and produced in the full range of trade sizes ½-inch through six-inch, in ten-foot and 20-foot lengths.

Assembly fittings include couplings, adapters, elbows, and a complete line of conduit access fittings.

Wheatland PVC plastic conduits are reported to be non-burning, high impact resisting, polyvinyl chloride conforming to industry specifications for corrosive resistance.

The Wheatland line of underground plastic conduits known as type I light wall and type II heavy wall are manufactured from specially compounded, modified styrene.

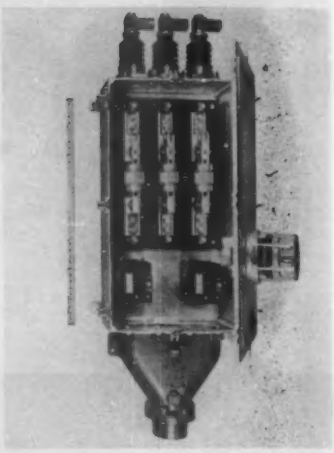
Type I light wall, designed for concrete encasement, is produced in trade sizes two-inch through six-inch. Type II heavy wall, for direct earth burial, is produced in trade sizes one-inch through four-inch. Both types, black in color with an identifying yellow stripe, are available in ten-, 20-, and 30-foot lengths.

Write in No. P-1127 on card, pg. 17

Hope current limiting units

Current limiting protection against high-value short-circuits, and provision for current metering on power circuits of 800 ampere-600 volt, is now available in weatherproof construction from Hope Electrical Products Co., 28 Long Ave., Hillside, N. J.

Similar Hope current limiting units, with and without aerial lugs or metering for 240-volt and 600-volt distribution systems to 2,000 amperes, afford protection to 100,000 RMS amperes. Wiping sleeves, stuffing boxes, or conduit entrances can also be provided.



Write in No. P-1128 on card, pg. 17

Fullman receptacle "key"

A "key" which drops into place in the adjusting ring has been added to the #190 steel adjusting floor box series made by Fullman Manufacturing Co., 1211 Jefferson St., Latrobe, Pa.

This "key" makes the use of most popular styles and size receptacles possible. The "key" is simply dropped into slots provided for in the adjusting ring, the receptacle selected is "laid in," the "key" is "laid on" the receptacle ring, and the three screws are tightened.

Write in No. P-1129 on card, pg. 17

Die cast conduit fittings

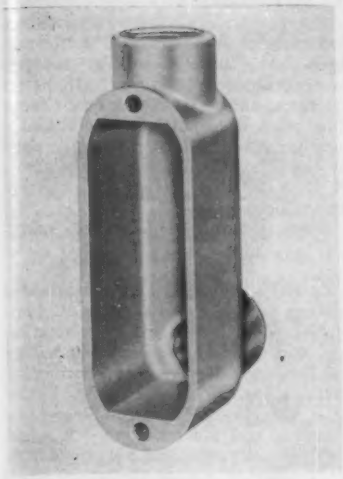
Environmental and economic factors that determine the choice of conduit controlled the reasoning be-

For the finest in friction, rubber or plastic tape, always look to ACCURATE . . . suppliers of "your best buy in tape."

Non-raveling
Straight tearing
High tensile strength
Strong adhesion
Highly insulating

ACCURATE TAPE
FRICTION ••• RUBBER ••• PLASTIC

ACCURATE MANUFACTURING CO./Garfield, New Jersey



hind the new die cast aluminum conduit fittings, just introduced by The Pyle-National Co., 1334 N. Kostner Ave., Chicago 51, Ill.

In some severe environments a copper-free aluminum fitting may be preferred. In normal indoor and outdoor environments, a copper-bearing aluminum fitting may be used more economically.

Series OR, Specification Grade, copper-free aluminum Pylets and blank covers have the protection of PEC-9 Epoxy coating, applied after Iridite treatment for the ultimate in protection against salt spray, acid fumes, strong caustics and organic liquids. Cover screws are of stainless steel.

Write in No. P-1130 on card, pg. 17

GE contactors, starters

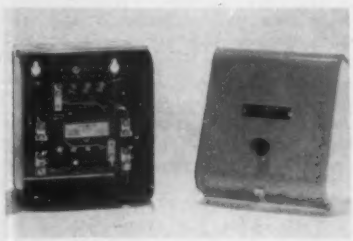
Size 00 magnetic contactors and starters for low-horsepower light duty applications have been added to its 100 line of motor starters by the General Electric Co., Schenectady 5, New York.

Designed specifically for controlling conveyors, small pumps and fans, the size 00 starter offers about an 18 per cent price saving over the size 0 starter which might have been used previously for such applications.

The new starters and contactors incorporate all the features of the 100 line, which include easier and faster installation, less maintenance, production reliability, and straight-out-the-front disassembly. In addition, the new units retain the family appearance of size 0, 1, and 2 starters and contactors.

Available for either 115 or 230 volts, the 00 starters and contacts are single, two- or three-phase with ratings from 1/3 to two horsepower.

Write in No. P-1131 on card, pg. 17



New product briefs

A new **commercial lighting lens** optically engineered to provide soft, even light between fixtures has been introduced by **Corning Glass Works,** P. O. Box 544, Corning, N. Y. The Pyrex brand general area lighting lens is made of tempered glass for increased mechanical strength and high heat resistance. The lens is 10⅞ inches square with convex contour.

Write in No. P-1132 on card, pg. 17

The new line of Slimlux **surface modules,** by the **Edwin F. Guth Co.,** 2615 Washington Blvd., St. Louis 77, Mo., offers complete versatility and variety for most 'on-ceiling' lighting requirements. Guth extra slim surface units are available in 1 x 4 feet, 1 x 8, 1½ x 4, 1½ x 8, 2 x 2, 2 x 4, 2 x 8 and 4 x 4 feet modules for rapid start and slimline lamps. Four different side designs and a vast array of bottom enclosures are available.

Write in No. P-1133 on card, pg. 17

Adding to its family of touch type switches, **Rodale Mfg. Co., Inc.,** 6th & Minor Sts., Emmanus, Pa., announces the introduction of the new **"Two Circuit Touchette."** Now only one switch is needed to control three-light lamps or to control two separate banks of lights on two separate circuits. Switch will carry 1800 watts at 120 volts, 4100 watts at 277 volts. At the first touch of the switch button the first circuit makes contact providing dim light. The second touch brings brighter light, while the third touch both activities full brightness.

Write in No. P-1134 on card, pg. 17

Pfaff and Kendall, 84 Foundry St., Newark 5, N. J., has just introduced a new all-aluminum residential **lighting post** designed specifically for use with the Holophane 431 Luminaire. The P & K post is made of the same high-strength aluminum alloy that is used in street and highway lighting standards. It is available in 7 foot and 3 foot models, the former standing approximately 5½ feet above the ground level.

Write in No. P-1135 on card, pg. 17

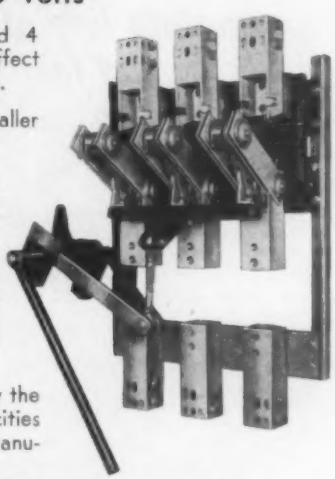
Surface-mounted **luminaires** with perforated-steel side frames are now available from the **Westinghouse Electric Corp.,** P. O. Box 2099, Pittsburgh 30, Pa. These frames provide

the KAM-LOK SWITCH

With pressure contacts

1200-6000A 250 and 480 volts

- Hollow terminals, twin jaws and 4 blades per pole give less skin effect heating and more cooling surface.
- Switch is more compact for smaller switchboard dimensions.
- Contact pressure mechanism has no springs, solder or cotter pins. Self-locking in closed position.
- Standard fuse mountings accommodate Amp-Trap 208 or 480, Bussmann KRP or KTX and G-E C-L-F fuses.



The **KAM-LOK** Switch is accepted by the Electrical Inspectors of most major cities in the south and by switchboard manufacturers serving that area.

SALES REPRESENTATIVES THROUGHOUT THE SOUTH

ATLANTA — Edgar E. Dawes & Co., 405 Rhodes Bldg.
(Also Birmingham, Greenville, Tampa, Jacksonville, Cleveland, Tenn.)
DALLAS — Wynne Snoots Co., 2nd Unit Santa Fe Bldg.
(Also Houston, Little Rock, Oklahoma City, Lubbock)
NEW ORLEANS — Associated Manufacturers Agents, 900 Carondelet St.
RICHMOND — Robert W. Fishburne, 1725 Arlington Road (Also Raleigh)
WASHINGTON, D. C. — Rumsey Electric Co., 337 Southern Bldg.

THE KELEK [k] COMPANY

259 DAVIS AVE. NORWOOD, MASS.

a modicum of light on the sides of fixtures, making their appearance superior to fixtures having plain metal frames. The new door frames, designed to hold either glass lenses or aluminum louvers, will be supplied with Westinghouse type-SF fluorescent luminaires. Models of type-SF luminaires accommodate two, three or four lamps having lengths of four or eight feet and ratings of 40 or 75 watts per lamp.

Write in No. P-1136 on card pg. 17

A new line of thermal-magnetic **circuit breakers** which offer overload protection for the entire range of industrial applications with only six frame sizes instead of twelve is now available from the **Westinghouse Electric Corp.**, P. O. Box 2099, Pittsburgh 30, Pa. The new breakers reduce the amount of space required for installation. Typical of the new frame sizes is the KA breaker (type K, model A) which can now be used instead of the old JK and K frames. The KA frame has an interchangeable trip, will carry up to 225 amperes, and will interrupt up to 30,000 amperes at 240 volts ac, as did the frames it replaces.

Write in No. P-1137 on card, pg. 17

An improved **safety switch** for heavy duty industrial applications has been developed by the **Continental Electric Equipment Co.**, Box 1055, Cincinnati 1, Ohio. The switch is available at present in Nema 12 and Nema 1A enclosures and carries Underwriters Laboratory listing as either a general purpose disconnect device or as service entrance equipment. Switches are available from 30 through 600 amperes, 240 volt and 600 volt a-c, and 250 volt d-c. An unusual design feature incorporates the switch and fuse load block assemblies mounted on a removable steel plate. During installation, this can be removed.

Write in No. P-1138 on card, pg. 17

Greenlee Tool Co., 2136 12th St., Rockford, Ill., announces the addition of their No. 777 **lightweight segment bender** for 1¼ inch through 4 inch aluminum or steel conduit and pipe. Weighing only 65 lb, exclusive of shoes, it can be easily transported and operated by one man. The advanced design of this bender makes it possible, with a few optional parts, to do 90-degree one-shot bending ½ through 2 inch, and thin-wall (EMT) bending ¾ through 2 inch.

Write in No. P-1139 on card, pg. 17

Three new **residential lighting fixture** lines have been recently introduced by **Moe Light Division**, Thomas Industries, Inc., 207 E. Broadway, Louisville 2, Ky. One line features the conventional pole light technique, which combines either pulldown convenience or bullet lights with pole light portability. A second line features pulldown lighting fixtures for kitchens, dining, or living room areas. The third line consists of contemporary pendant designs for use in pairs or clusters. This latter group comes in such finishes as cocoa or hand-blown opal glass.

Write in No. P-1140 on card, pg. 17

Entirely new Sky-Glo **illuminated ceilings** designed for greater efficiency, versatility and savings in installation and servicing are announced by the **Benjamin Division of Thomas Industries, Inc.**, 207 E. Broadway, Louisville, Ky. The new Sky-Glo system is based on 2 x 4 foot and 2 x 2 foot vinyl, polystyrene and acrylic diffusers. Featuring a new acoustical vinyl panel, Sky-Glo is also available with a variety of prismatic diffusers plus ½ inch cube aluminum or plastic louvers.

Write in No. P-1141 on card, pg. 17

A new **conduit adjustable extension ring** made by **Arrow Conduit and Fittings Corp.**, 108-20 180th St., Jamaica 33, N. Y., is ideally suited for alteration work in older buildings where new ceilings are to be installed and in new buildings where plans have been changed. A special slot arrangement of this device allows the extension ring to be turned in either direction, to line up knockouts with incoming conduit. The ring is also designed for easy coupling with the already installed ceiling box.

Write in No. P-1142 on card, pg. 17

A new compact, packaged **busway** of 100 ampere capacity made at the company's Linden, New Jersey, plant is now being marketed by **National Electric Division**, H. K. Porter Company, Inc., 140 Stanwix St., Pittsburgh 22, Pa. The new "Speedbus" was designed to afford the complete flexibility of a true busway system at an installed cost comparable to conventional conduit and wire. Designed for all commercial uses, three and four wire constructions are standard.

Write in No. P-1143 on card, pg. 17

The new line of Type QO **circuit breakers** made by the **Square D Co.**, Mercer Rd., Lexington, Ky., has been expanded with the addition of the Type Q1 breaker, available in 70 and 100 ampere trip ratings for two and three pole applications.

Standard Q1 breakers are supplied with terminals suitable for use with both copper and aluminum conductors. Lugs are Underwriters' listed for copper cable Size #1 to #8 AWG and aluminum cable Size #0 to #6 AWG. Plug-in construction simplifies installation; Q1 breakers can be wired outside the box and then simply plugged on to the bus for line connection.

Write in No. P-1144 on card, pg. 17

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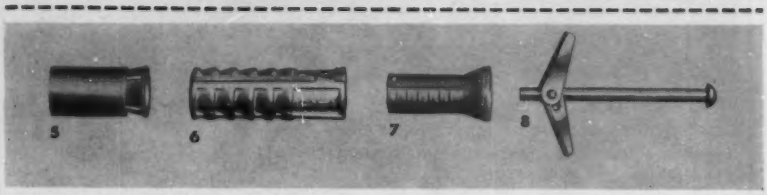

1. Famous Blackhawk Snap-Strap for rigid conduit is a time saver. Has exclusive "hold-bump." Provides rigid contact support.
2. Snap-Strap thinwall conduit — same style as the 700 line made to fit thinwall conduit.
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8. SPRING TYPE TOGGLE BOLTS zinc plated, double wings lock tightly to screw under pressure. Prevent loosening by vibration. Round head screws, zinc plated, fully threaded.

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Helpful literature

available to our readers

GEC-983P is a 20-page bulletin containing tables of data and prices for the full line of **ballasts** for fluorescent lamps of **General Electric Co.**, 1 River Rd., Schenectady 5, N. Y. Publication describes applications and operating data for rapid start, instant start, preheat start, and trigger start ballasts. Information on ballasts for Circline lamps, outdoor applications, dimming, germicidal lamps, suppression of radio interference, and home appliances is included.

Write in No. B-1145 on card, pg. 17

"Development and Testing of **Suspension Hardware** for Transmission Systems," a technical paper prepared and originally presented by R. A. Eucker, senior engineer, Technical Service Section, **Preformed Line Products Co.**, 5349 St. Clair Ave., Cleveland 3, Ohio, at a meeting of the Pennsylvania Electric Association, Transmission and Distribution Committee. is now available in the form of a 20-page illustrated booklet. Covered are subjects related to the longevity of high voltage transmission lines through the application of improved support hardware.

Write in No. B-1146 on card, pg. 17

A new, completely illustrated, 44-page descriptive booklet on **power transformers** has just been released by **Pennsylvania Transformer Div., McGraw-Edison Co.**, Box 330, Canonsburg, Pa. The multi-colored booklet (No. P-560) covers design features, construction details, and principal accessories of the company's "Contour Design," shell-form transformers.

Write in No. B-1147 on card, pg. 17

A bulletin showing 27 fluorescent and incandescent **luminaires** designed for architectural application has been published by the **Gotham Lighting Corp.**, 37-01 31st St., Long Island City 1, N. Y. The catalog includes complete description of all equipment, candlepower distribution curves, coefficients of utilization, and efficiencies, as well as detailed drawings, photographs and material specifications.

Write in No. B-1148 on card, pg. 17

The Fanner Manufacturing Co., Electrical Products Div., Brookside Park, Cleveland 9, Ohio, announces a new and expanded catalog of its complete line of plastic **Treeguards** for protection of overhead lines from tree-limb abrasion. Catalog Section TG contains complete selection and specification data for single, duplex, triplex, quadruplex and multi-cable conductors in a wide variety of shapes and arrangements.

Write in No. B-1149 on card, pg. 17

Bulletin LA4, illustrating Type F intermediate-class **lightning arresters**, is now available from **Line Material Industries**, McGraw-Edison Co., 700 W. Michigan St., Milwaukee 1, Wis. Type F arresters are offered in standard voltage ratings from 20 through 121 kv. Included are application information, design and operating features, and ordering and dimensional information. Various arrester mounting brackets also are described.

Write in No. B-1150 on card, pg. 17

Features which contribute to speedy installation of small, quiet **dry-type transformers** in ratings 3 through 50 kva, single-phase, 600 volts and below, are described in a new bulletin 61B8222B, released by **Allis-Chalmers**, 938 S. 70th St., Milwaukee 1, Wis. Curvacore construction of the 80 C rise, ventilated, indoor dry-type transformer which provides quiet, low loss, low exciting current operation is described in the bulletin, which includes dimensions for the unit.

Write in No. B-1151 on card, pg. 17

A new four-page bulletin on "Donut" **current transformers** for metering and allied applications, has just been issued by **Associated Research, Inc.**, 3777 W. Belmont Ave., Chicago 18, Ill. These current transformers are used for extending the measuring range of ammeters, and provide current to operate relays and other control circuits. The bulletin lists two hundred types in burden ratings from 2.5 to 12.5 kv and turns rations from 10/5 to 5000/5.

Write in No. B-1152 on card, pg. 17

A new bulletin describing in detail its completely redesigned line of 4160-volt **metal-clad switchgear** has been published by **I-T-E Circuit Breaker Co.**, 1900 Hamilton St., Philadelphia 30, Pa. The two-color 20-page bulletin gives comprehensive information on the complete line of indoor and outdoor, both minimum depth and walk-in type equipment which is available in ratings through 3,000 amperes continuous current and 250 mva interrupting capacities.

Write in No. B-1153 on card, pg. 17

EJS Lighting Corp., 921 E. Pico Blvd., Los Angeles 21, Calif., announces publication of a new eight-page "short" catalog of special interest to contractors. Almost 100 separate, distinctive residential and com-

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PORCELAIN
RECEPTACLES
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OPEN-TOP WIRING — ready for immediate wiring — speedy and easy installation without removal of the interior mechanism. DUST-PROOF (Completely enclosed) INTERIORS with extra large binding head screws that are backed out and staked. Replaceable interior gives absolute satisfaction on full rated loads with performance that far exceeds Underwriters' Standards. Porcelain Receptacles No. 1736 and 1924 are pull-chain, three piece with shadeholder groove. For 3¼" or 4" box.
No. 1734 is our all-time favorite, with shadeholder groove. For 3¼" or 4" box. Complete with chain and cord.
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mercial **fixtures and brackets** with a wide variety of applications, including many original designs exclusive with EJS, are featured in the new book.

Write in No. B-1154 on card, pg. 17

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill., announces the release of its 1961 catalog of electronic equipment. Special emphasis has been placed on **electronic equipment for industry.** Allied's new 576-page catalog, the largest catalog published by any electronics supply house, lists over 48,000 items and includes 240 pages in rotogravure. Covers are reproduced in 4 colors. The catalog includes extensive listings of parts and equipment for industrial maintenance, research, and production requirements.

Write in No. B-1155 on card, pg. 17

Data on **rigid aluminum electrical conduit** is brought together in an illustrated detailed 32-page manual now available from **Kaiser Aluminum & Chemical Sales, Inc.,** Kaiser Center, 300 Lakeside Dr., Oakland 12, Calif. Physical properties and performance factors of **rigid aluminum conduit** are compared to steel conduit in indexed charts, tables, and text. Such subjects are covered as weights and dimensions, allowable fill for new and rewiring projects, corrosion resistance in various environments, and comparative voltage drop with 250 to 1,000 MCM conductors in nonmagnetic aluminum and conventional magnetic raceways.

Write in No. B-1156 on card, pg. 17

Benjamin **audible signal equipment** suitable to almost every industrial signal need is shown in the new catalog offered by the **Benjamin Division of Thomas Industries, Inc.,** 207 E. Broadway, Louisville, Ky. Complete diagrams, specifications and mounting methods for all listed signal equipment are given in detail, as well as general information on the various types that are most suitable for specific noise level areas. Also included is the UL recommended class and group usages for the various signals.

Write in No. B-1157 on card, pg. 17

Just off the press is a new 32-page fully illustrated catalog featuring the latest developments in push button **switches, plugs,** jacks, adaptors, connectors, shielded jacks, and cord mounted jacks. The catalog, from the Electrocraft division of **GC Electronics Co.,** 400 South Wyman St., Rockford, Ill., illustrates all products with an actual photograph, as well as a dimensional drawing.

Write in No. B-1158 on card, pg. 17

Pfaff and Kendall, 84 Foundry St., Newark, N. J., has recently issued a new street and highway standard catalog. The publication is basically a working engineering specification brochure, which in 16 pages, with over 20 drawings, covers complete and detailed data on the various Pfaff and Kendall **lighting** standards. Details include luminaire specifications, arms, bases, anchorage, etc.

Write in No. B-1159 on card, pg. 17

Hundreds of interesting pieces of information about **lightning,** nature's most destructive force, are contained in a new edition, just off the press, of "Lightning Facts and Figures", prepared by the **Lightning Protection Institute,** 53 West Jackson Blvd., Chicago 4, Ill.

Write in No. B-1160 on card, pg. 17

A packet of descriptive and illustrated literature on both radiant and fan-forced **electric heaters** is now available from **Arvin Industries, Inc.,** Electric Heat Div., 13th and Big Four Rd., Columbus, Ind. The material is in color, with full specifications included for wall, baseboard, and ceiling heaters and controls.

Write in No. B-1161 on card, pg. 17

Code questions

(Continued from page 108)

Will you please give an opinion on this.

ANSWER: From what I can determine, no conductors have been connected in multiple. You have two switches feeding two separate loads. You are allowed six switches and have used only two. I see no violation. Before conductors can be said to be connected in multiple, both ends of the two or more sets of conductors must be connected to the same load. Your connection, by contrast, receives a common supply and terminates in two separate loads.

Know the law

(Continued from page 100)

of the lessee should secure a written order signed by the lessee showing his assumption of liability to the contractor for payment.

Had an electrical contractor secured the lessee's signature in such a case, he probably would not have been put to the trouble and expense of suing the lessee. (Larsen v. Lane, 158 Atl. 2d 759, decided by the Maine Supreme Judicial Court.)

When electrical contractor Larsen sued Lane, lessee of meat market space in a building, he claimed that he was called by the latter to do certain repair work

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essential to receiving electric service for the store, that the owner agreed to pay for that part of the repairs beneficial to the entire building, and that Lane orally promised to pay the balance. When contractor Larsen sued Lane on that oral promise, Lane denied that he had so agreed. But the Supreme Court decided that the jury justifiably believed Larsen, not Lane.

Washington report

(Continued from page 8)

per cent more than that in August. This is the report of the U. S. Census Bureau. Usually construction outlays hold at the same level in September as in August.

The value of the new construction in September was $5.3 billion. In the first nine months of this year contractors put in place $40.8 billion worth of new construction, three per cent less than in the first nine months of 1959.

Economists at Washington are saying that this will be the first year in a decade in which the value of new construction failed to exceed that of the year before.

Load indicator

(Continued from page 65)

generalized form in Figure 1. This structure has been designed to create within it magnetic heating proportional to transformer (conductor) load. By suitable configuration, it is possible to concentrate the resultant heating of the magnetic structure within a portion where it can be used as a means for operating the indicator. Because of its dual function, this structure has been named the "magnethermic element." By suitable design manipulation of the dimensions and composition of the "magnethermic element" and the insulating structure about it, it is possible to produce the type of indicator load response required.

Response and indication

The experience and recommendations of operating engineers were drawn upon to determine the characteristics of the indicator most desirable from the users' standpoint.

Response of the indicator, it was concluded, should be patterned after that of a "one-hour" demand meter. This permits rapid response to economically significant load peaks, yet reduces the influence of short load "spikes" of little economic significance. In addition, it was felt that a limited variation in response with ambient temperature should be permitted since it influences system peaking capabilities and, to some extent, economics.

The output of the indicator actuator, a bimetallic device, can be presented in several ways. These include

(1) A signal light, similar to the CSP overload light, operating at a predetermined load level.

(2) A direct dial indication of demand or maximum demand, or both.

(3) A combination of the above.

The widespread use of the CSP light as a load monitor indicated that the initial version of the "TL" indicator should incorporate the light. Addition of the direct demand indication received mixed response and therefore has been eliminated from the introductory model.

A typical "load-time" curve for the "TL" indicator with the light is shown in Figure 2. The fast response and variation of indication with extremes in ambient temperature are shown. The indicator is being provided with calibrated knob for field adjustment of the operating level if so desired. This level can be set so it will match the loading practice of any operating company. Further, the field adjustment of the indicator provides a simple method for permitting changes in loading practice because of variations in load characteristics. The "TL" indicator is therefore capable of wide applications.

Details of indicator operation

Operation of the basic "TL" indicator is shown in Figure 3, which is a cutaway view of the internal mechanism. The heart of the indicator is the "magnethermic" element (2) through which the transformer L.V. secondary drops (1) are passed. Within the center portion of this element is located a bimetallic device (3) that serves to actuate the light switch (5), thereby energizing a neon light (4).

A small permanent magnet (6) serves to lock in the light following actuation. The light can be reset during light load periods by means of plunger (7), if desired.

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Dallas, Texas

Voltage for the light is taken directly from the transformer secondary by means of insulated leads (8). As protection against lightning surges, the indicator is provided with a small meter-type de-ion gap. A small decal (9) on the back of the indicator case identifies the transformer kva rating with which the unit was designed to operate.

Installation

Provision has been made for mounting the "TL" indicator directly on the L.V. neutral grounding pad located on all distribution transformers built over the last 25 years. This positions the indicator so that the two line leads of the L.V. secondary drop can be passed through the holes provided in the back of the indicator case (Figure 4). The L.V. neutral need not pass through the indicator. The signal light leads can be attached directly to the transformer L.V. bushings (line to neutral, 120 volts). No adjustment of the indicator or modification of the transformer is required.

Although primarily designed for direct transformer mounting, it is possible to mount the indicator on the pole or elsewhere. The only requirement to be satisfied is that the L.V. line leads pass through the indicator.

Operating cost

Operating costs for the indicator can be considered negligible. Combined losses in "magnethermic element" and light are only three watts at rated load and about eight watts at 200 per cent load. Life of the indicator should be far in excess of requirements and should have little economic significance because of its low initial cost.

Fault currents

(Continued from page 69)

complished in almost any station with a minimum of effort.

Previous to the installation of this reactor there had been numerous operations of the relay-controlled station breakers and blowing of high side fuses for no apparent reason. Even though we did not measure the fault currents on the system before and after the installation of the reactor, we have every reason to believe that this installation has brought about a better condition of coordination between fuses, station breakers, and reclosers.

After two years of successful operation of this reactor it was decided to use it at two additional locations when their capacity was increased above 2,000 kva. These two additional installations have been made and are performing without difficulty.

There are additional advantages to be realized by limiting fault currents. If there is any appreciable resistance in a connection, a high current will cause a burn down. One of the greatest advantages is the protection to power transformers. Even though power transformers are designed to withstand the forces created by fault currents there is a factor of safety in limiting their value.

In this area of lightning, wind, and trees we have more than 100 large fault currents per year as determined by our instantaneous ground relays. There is no doubt that in limiting these magnetic forces to a fraction of their possible value, the mechanical strength

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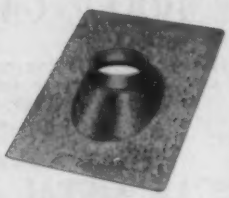

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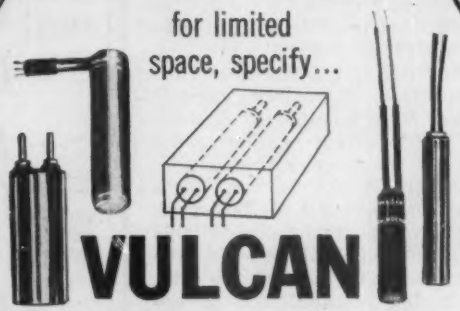

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Vulcan Cartridges are available in a wide choice of standard sizes — from 1" to 25" (or longer); diameter — 1/4" to 1 19/64" (or greater); sheath — brass, steel, nickel or high temperature alloys; full range of wattage and voltage ratings. *Write for catalog and prices.*

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of the transformer is retained for many years.

To my knowledge this is the only installation on an REA system in the United States where a reactor is installed in the neutral for limiting line-to-ground faults. The greatest good is derived in the first few miles from the substation where the maximum fault currents occur.

In the early days of rural electrification the low fault current was a problem. Now, with the large loads, large conductors and increased capacity of substations, fault currents should be limited. The reactor seems to be the solution to the problem until more expensive protective equipment can be justified.

Substations

(Continued from page 74)

some installations. These wires should be connected at least at the middle and at both ends to ground rods. While it may be desirable in some cases, it is not always necessary that they be connected to each other or to the cables interconnecting the rods. Their effectiveness in distributing the voltage is not impaired if they break or burn open in spots so long as one end remains connected to the ground system.

Effect on reducing potentials

Figure 10 shows the effect of such a grid system in reducing potentials over a portion of substation area. This is based on actual measurements and indicates that a substantial reduction in the voltage can be obtained by placing grid wires at closer spacings. For example, the curve Test 4 which was obtained with wires spaced at about 3¾-foot intervals indicates that the potentials inside the grounded area were approximately one-third of the values obtained when no grid or counterpoise was used.

It is evident that further reduction in potentials can be effected by using closer spacings of the grid wires. This may be necessary in some cases, but in general, spacings less than about 2 to 2½ feet, which is approximately a normal step or pace, are seldom necessary. This will depend largely on local conditions but smaller spacings begin to approach the effect of a fine mesh or solid plate.

It will be apparent from the foregoing that there are many factors involved in the design of a substation grounding system and that each installation must be treated as an individual problem. An adequate grounding system can usually be justified from an economic standpoint when the matter of safety to life and property is considered. While the cost of such a ground may seem high, it probably represents only a relatively small percentage of the total overall cost of the substation. The protection which it affords to human life will far outweigh any consideration of the cost.

Polyphase meter

(Continued from page 68)

of concern and requires a great deal of verification in order to be satisfied that it is correct. With a resistive load, however, this problem is eliminated and the meter should run forward at all times and on all stators.

Only one unit for each voltage would be required in the meter shop since the number of installations requiring its use would be limited. It would be easy to carry, since it would weigh less than ten pounds, and would be inexpensive to make. If construction of such a unit saved one extra trip then it would be worthwhile, and if it saved one error, then it would be of great value to effective metering.

Coastal line

(Continued from page 63)

and bolted to the piling above the water line. Proof of the prevalence of borers is found in the poles being removed from the areas crossed. These poles vary in age from five to 20 years and show consistent limnoria attack. The toxicity seems to have been high enough in each case to have protected against teredo.

Pilings in this installation vary in length from 35 to 50 feet and were driven to a depth of 25 to 40 feet. Standard drop hammer type pile-driving equipment was used for the installation. Vertical piling loading values, which were easily obtained, were of little practical value in this construction since a maximum of one and one-half tons per pile was the total load per installation, whereas the side thrust load as produced by windage and conductor action was difficult to obtain. In fact, we have found no reported information on this particular type of loading.

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Many of today's switches are specialties primarily designed for appeal in decoration. Others are designed to meet the rugged use and performance called for by a heavy duty switch.
Now, one new switch, Rocker-Glo, combines eye-appealing design with heavy duty performance. So impressed with this combination are architects, engineers and contractors that Rocker-Glo is already being specified in leading hotels, motels, hospitals, commercial buildings and housing developments. Rocker-Glo has high-grade silver alloy contacts. Its modern design and unique construction allow this switch to be pressed, pushed, rocked or rolled into instantaneous action.
Rocker-Glo switches are designed to be used at full current rating on tungsten filament and fluorescent loads. Available in Despard interchangeable type, Despard type mounted on a strap and narrow rocker for tumbler switch plates. A specification grade switch, 15 and 20 amps. 120/277 volts AC.

P&S *Write for free Rocker-Glo bulletin — Dept. ES-116.*

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All piling was installed by contract and line work was done with the company crews. Transportation to and from all poles in the water was by power boat, usually on a contract basis.

The lines installed were four-wire 7.2/12.5 kv of #4/0 copper with #2/0 neutral. A 45-kv fog-type insulator was used to protect against the heavy corrosion in the area. Past experience has proved the necessity of over insulation in these areas. An unusual construction situation encountered was a 70-foot clearance required over the Intra-Coastal Waterway, with a 300-foot span.

Power equipment

(Continued from page 36)

dling are incalculable. An electric keyhole saw for cutting holes or outlets in wood or metal is another automatic tool that has proven a fine labor-saver as it performs a neater job. The drive-it gun for shooting studs in concrete or cinder block is another worthwhile investment.

Power tools properly applied, properly handled, and properly maintained are an investment that pays well in dividends.

Feeding, storage plan

(Continued from page 34)

motor operates the auger to spread the feed.

The only part of the operation that is not electrical, on standard 220, REA-supplied power, is the grinder, where an auxiliary gas engine is being used at present.

Mr. Briscoe has a compact and versatile one-man feeding and storage operation, and maximum use of electrical potential has made his profitable operation possible.

He sees no reason why any farmer cannot be sold on full use of electrical "hired hands"—if the farmer has any interest in staying in business and making a profit.

Underground system

(Continued from page 62)

involved a transition from an aluminum cable to the copper connector. After being assured by the connector manufacturer that a suitable transition could be made, aluminum was chosen as the conductor material.

The connectors are rated at 1,500 amperes per phase except in transformer vaults where they are rated 2,000 amperes for lighting phases and are installed in sufficient number and with the required number of outlets to provide three-phase service to each lot served.

In addition, single phase service is supplied for each street light, vault, and entrance gate. Four spare outlets for each lighting phase and two spare outlets for the power phase are supplied in each transformer vault, along with two spare terminals per phase in each manhole and handhold, with suitable outlet plugs on all unconnected outlets.

Connectors tested

Two types of connectors were thoroughly tested by their manufacturers and Florida Power and Light. Both proved to be satisfactory for the transition from aluminum to copper. With one, the cable could be removed without cutting. The second, in which the transition was made at the factory by joining the aluminum barrel to a copper dowel which was made as a part of the copper receptacle, enabled the use of extremely high pressures applied to the connection, thus fusing the aluminum barrel to the copper dowel and giving a much better connection.

Since the secondary was essentially an electrical bus consisting, in most cases, of multiple 350 or 500 MCM cables in parallel, the latter type connection was chosen. However, the easy disconnect feature of the other will undoubtedly be given strong consideration by the utility in connecting aluminum services as they are installed.

A viewpoint on the connectors chosen was voiced by Woody Hodges, who handles the cable work for the local utility. "We'll reserve decision until we see how they work out. They're difficult to repair; copper connections are smaller and copper wire is easier to handle, and that's mighty important in restoring service fast. And you don't need a kingsize compression tool as is required on the aluminum connections."

The multiple connectors were pre-insulated with a neoprene base compound and a neoprene sleeve over the barrel part of each connector. A watertight, insulated connection was made by taping the sleeve to the cable and the multiple connector with rubber and neoprene tape.

Reason for the selection of paper-insulated, lead covered, neoprene-jacketed cable for the pri-

mary circuits is stated by Mr. Bailey, the design engineer: "This type cable, when provided with proper cathodic protection, has proved to be more maintenance-free than rubber-insulated cable in this section of the country.

"Copper was used for the conductor material, along with standard wiped joints and pothead terminations. "Aluminum was investigated for this primary conductor, but the increased conductor size required with aluminum increased the insulation and lead covering cost more than the savings of aluminum over copper conductors."

Primary cables fireproofed

Primary cables were fireproofed throughout all the transformer vaults and in manholes containing more than one primary circuit or more than one section of the same circuit. Primary duct banks carry three 1/c #3 15 kv copper cables and one #4/0 neutral of copper, chosen for copper's better corrosion resistance in salt spray areas that surround the Bird Key subdivision.

The system neutral is neoprene-covered copper wire with all connections made with compression type fittings and wrapped with neoprene tape. A typical aluminum secondary ductbank carries two 350 mcm-600 volt cables per lighting phase; two #1/0, 600-volt cables of aluminum for the power phase, and two #4/0 neutral conductor, along with one 2/c #6 street lighting cable.

Two grounds maintained

Two separate grounds, one for the system neutral and one for the lead sheath, are maintained throughout the entire subdivision. These grounds are isolated from each other so cathodic protection could be provided for the lead sheath.

A system ground, a lead sheath ground, and a zinc anode were installed under each transformer vault and manhole, with the lead sheath ground and zinc anode connected to the cable sheath at the entrance to each vault and manhole. Insulating spacers between the oil switch potheads and the switch cases isolate the cable sheath from the vault equipment, while all vault equipment is connected to the neutral system ground.

However, insulating spacers were not employed for the potheads serving the transformers, so their cases and the cases of the oil fuse cutouts can be maintained at the system neutral potential.

Provision has been made for underground telephone service by the inclusion of ducts installed by Whitmore Electric, with direct burial cable serving street lights located within a few feet of manholes and handholds. Transite pipe carries telephone cable at street crossings.

Main trunk lines have been directly buried in the street right-of-way and the rear lot easements and terminal posts are located above ground near the handholds. A one-inch plastic pipe extends under the street pavement from each terminal post, to serve the lots on the opposite side of the street.

"Excellent system"

As design engineer for the project, Mr. Bailey concludes: "In our opinion, the Bird Key subdivision has an excellent electrical

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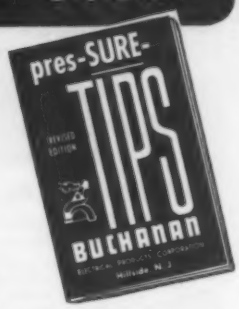

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distribution system designed to meet today's high demand for electric living, and to provide each home owner with ample spare capacity for the increased use of electricity that is sure to come in the years ahead."

As to why the job was contracted out to an electrical contractor and not undertaken by the local FPL unit, manager James Spencer said: "We contract out such projects as our distribution buildings and submarine cables—jobs normally beyond our organizational scope and which we're not prepared to attempt from the standpoint of the needed men and equipment. We won't build up a big temporary labor force, nor do we take kindly to investing in heavy and specialized equipment for jobs too big for our local people. Our opinion negates the idea of building any unwieldy and short-lived monetary and organizational set-up required on a job like Bird Key. It just wasn't feasible to undertake such temporary expansion, then have a surplus of men and equipment at job's completion."

Obviously any utility can skid its wheels profit-wise and efficiency-wise when it steps outside its regular and established framework of operational activity. While a utility might have better control of the quality of work being done when installation is by its own personnel, in the case of FPL, its engineering staff, plus the efforts of outside engineering and its own strict specifications, defining requirements they expected of the electrical contractor, attracted bidders of proven integrity, business experience, financial stability, and willingness to guarantee performance.

The inevitable result of this policy has assured FPL an underground system whose trouble-free performance is bound to be reflected in the form of better service to its customers.

Contracting profits

(Continued from page 27)

terials control, a purchase order system for all materials except petty cash purchases was designed. So that materials may be charged to the appropriate jobs, a rubber stamp of job number, code designation, purchase order number, date, and signature of person receiving materials is employed by the men on the jobs responsible for materials.

After materials have been properly inspected and checked, and delivery slip filled out and stamped, the delivery slip is sent to the warehouse where it is matched with the purchase order. These are then checked with invoice, and materials are charged to a job from the invoice.

More jobs handled

Our revamped operation, clearly defining each one's duties in our new systems, has made possible handling a substantially increased volume of contract jobs in all fields. A factor in obtaining an increasing number of jobs has been our accurate estimates. Knowing at all times what the financial picture is on every job, we make jobs consistently profitable.

Delegation of duties has given me more time to study, seek jobs, and sell more jobs. Also, I have more time for collections, so our accounts receivable are in better shape than they have ever been.

It is reorganization that has helped us achieve our objectives in shorter time than would have been otherwise possible.

Small contractors

(Continued from page 32)

Every electrician has his regular eight-hour day, six days a week, throughout the year. Not one hour of lost time and no hills or valleys in earnings occur. No one was idled during the Christmas and New Year holidays. With substantially higher wages than any other non-union shop in the area, every one of these electricians feels he is better situated than if he were in business for himself.

My duties are similar to those I

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would have in an independent operation of my own—without the headaches. I hire personnel for my department, train them in methods that adapt to the 12 localities we work in, reward with raises in pay, estimate, assign mechanics to jobs, plan, and inspect the carrying out of work. However, I am not burdened with the paperwork, office staff, investment in building, stock, equipment, or promotion. Paid vacations now really leave my mind free of anxiety.

I believe that a trend is afoot when more one-man contracting operations will buckle under the growing complexity of the load. Though I can well appreciate every electrician's ambition of heading a successful business of his own, I believe it is getting more and more difficult to make the grade.

Apartments

(Continued from page 31)

$24, with the low bill about $8. At La Villa the high bill is expected to run around $30, with the low bill around $10.

"It's the only system we know where the owner has the option of paying or letting the tenant pay. The whole operation is tailored to the tastes and convenience of both the tenant and owner."

Scheidt said three more such apartment projects are in the works, with no alternate system bids taken, and four more show a 50-50 likelihood of going to all-electric heat pump operation.

Acceptance in the Oklahoma City area has been quick and strong, and more and more contractors will be called on for such installations.

Underfloor cable

(Continued from page 24)

part of either of its buildings to be heated as desired without waste of current. For example, when attendance is small only that part of a building where people are to assemble is heated. Because the heating is in the floor, it remains largely in its area.

The church heating pattern is divided along the center aisle and is controlled by seven thermostats along each of the sidewalls. Thus, for heating, the floor space may be divided lengthwise or crosswise. The parish hall has this same convenience.

The thermostats control heating from 55 to 85 degrees. On days of heating use, they are set for the desired temperature five hours ahead of time. After the desired temperature has been reached for two hours, it remains constant for several additional hours with the thermostats turned off. Disconnect switches have been provided for periods when the buildings are not in use.

We are now beginning to see the possibilities for underfloor cable heating for all types of buildings with concrete, terrazzo, tile, or vinyl floors. It is easier and more economical to install than ceiling heat. It is highly adaptable for motels, schools, churches, offices, business buildings, and homes, especially in the South. It is excellent for bathrooms.

Underfloor cable advantages

Underfloor cable heat has no mechanical parts, it is permanent, economical, and efficient. It produces heat in a short time. It requires no space or fueling. It is safe.

Through a particularly cold Florida winter, when the temperature actually dropped as low as 27, underfloor cable heating performed perfectly. We have never had an electrical installation with such pleasing results.

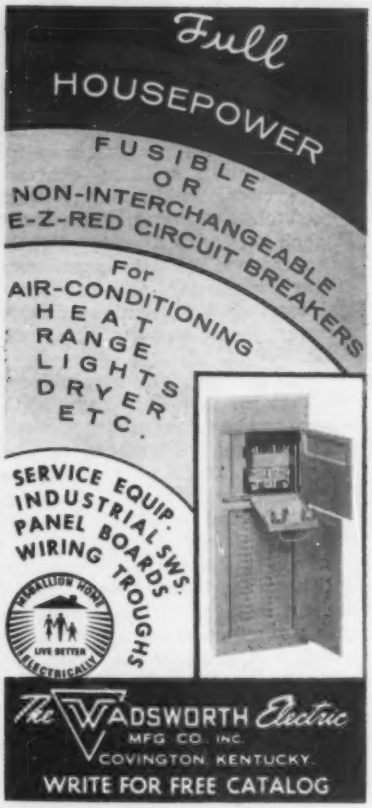
I do not know why Southern contractors have not used more of it. Maybe it is because many of them are like us—they just didn't know about it. I hope now they will investigate its possibilities.

Two humorous incidents happened in connection with our church heating job. When the Sunday school rooms were first used, the children were soon sitting on the floor, finding it comfortable and more fun than to sit in their chairs. In church, on the first Sunday the new heating system was used, several women parishioners could not resist the temptation of taking off their shoes and warming their stocking feet on the pleasantly heated floor.

Training course

(Continued from page 23)

believe the manufacturer's responsibility goes beyond designing and selling a quality product. To bring the benefits that only electric heat can provide the modern homeowner, manufacturers must also develop a close working relationship with installers, architects, builders, distributors, and dealers to insure the long-range success of their products. This is



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the objective which underlies all our planning for this market. This training program, we feel, is the most outstanding example of this thinking."

Emerson Electric distributors will administer the program in cooperation with utilities, contractors' groups, and company field personnel. The material presented at each session will vary slightly in accordance with the experience of the "students", and geographical location which might dictate more emphasis on certain applications.

"This course gives several new 'tools' to the installer," says W. C. Nusbaum, assistant to the president of Emerson, whose special assignment for the past six months has been researching, planning, and gathering material for this training program.

"An installer taking this course will be given a simplified method of heat loss calculation which results in a permanent record and which will improve his speed and accuracy on the job. He will receive a simplified guide to equipment choice; an objective, easy-to-understand explanation of how various types of heating equipment function as a basis to understanding equipment application; and a practical proven sales approach of particular value in conversation applications.

"Electrical contractors and other installers already have the basic qualifications for entering the electric heat business: qualified personnel, installation equipment, sales ability, prospects, and customers. After completing this course, we feel that they will be equipped with the specific skills necessary for successful participation in a market that offers them a present annual consumption of $27,000,000 of manufactured electric heating equipment.

Emerson Electric's builder products group now manufactures a complete line of electric heating. Products include baseboard units; in-the-wall fan-forced and radiant units; radiant cable; Northwind heat pumps; and Emerson-Pryne radiant, convection, and infra-red ceiling and wall heaters.

Underground system

(Continued from page 22)

by such obstacles as quicksand and washouts from torrential downpours. When it came to excavating, wellpoints were often impractical since water simply remained atop the old silt and clay. Because of the fluidity occasioned in the 4,000,000 yards of bay bottom fill, difficulty was encountered in keeping water out long enough to set the transformer vaults.

This problem was solved by welding and so bracing a steel box-like form with open top and bottom, that it barred entry of water into the vault excavation holding the 14-foot-long concrete units.

At times, newly-laid duct was lifted right out of the ditches by a sudden rainfall and had to be pulled out and reset.

Understand payment basis

Whitmore stresses: "It is most essential that the contractor thoroughly understand the basis of measurement as it involves payment for every operation and materials used.

"If this basis calls, for example, for cable payments from centerline to centerline of the structure, he must not forget to include in his cost estimate allowances such as the necessary slack for racking, cut-off, splicing, and fireproofing, and, in the case of our aluminum secondary, the extra cable loops for the required connections to the connector used in the transition from aluminum to copper.

"Some contracts call for payment only for actual installed footage, omitting cut-off and racking. The contractor must find out just what the unit price covers, and everything that is required for the installation must be included in the cost estimate so he can figure accurately and not forget some major item like fireproofing on which we ran $15,000."

In the Bird Key job, this item (fireproofing), was included in the unit price for the cabling.

"Generally," says Mr. Whitmore, " in a good set of specifications, this is spelled out. But if the 'specs' fail in this respect, then the electrical contractor who seeks to avoid later hassles needs to be forewarned to the point of questioning the engineers prior to bidding the job. 'Specs' may not be complete or correct, and the margin of error thus encountered on a large installation is too great to neglect investigation.

"For example, on our secondary cable we had to buy ten per cent more than we were actually paid for, because we had to pull from one to three feet extra at each hole. We had foreseen this in our estimate, but not to the tune of ten per cent, yet it ran exactly that to the foot, as is recorded in our files. Other jobs have run less, but the Bird Key project ran to a 10 per cent excess of installed cable."

As to the connections used on the secondary system, for which he says no experience data is available, Mr. Whitmore is willing to impart such information to others involved in similar work.

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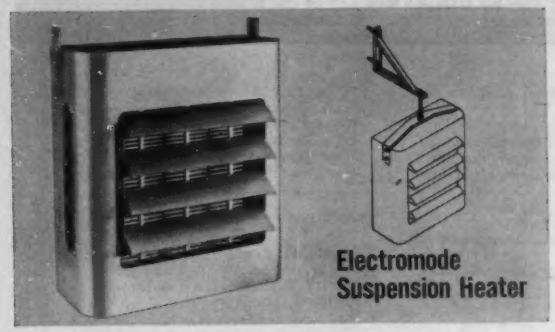

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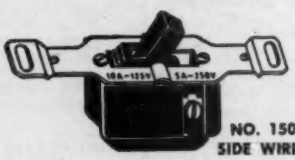

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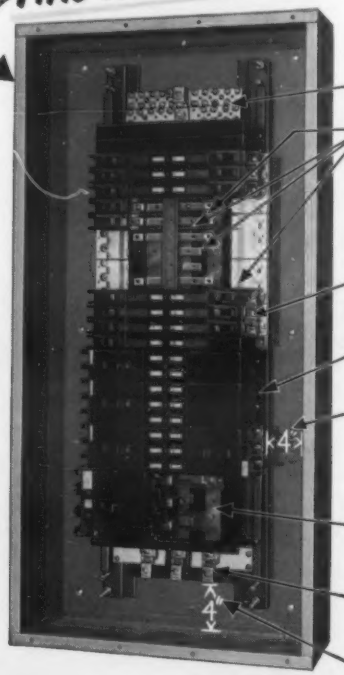

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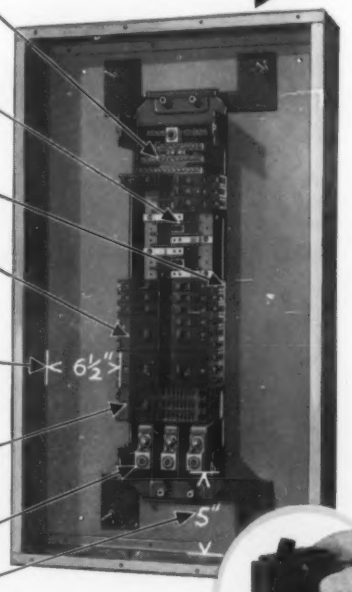

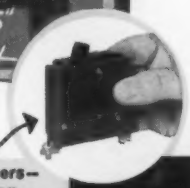

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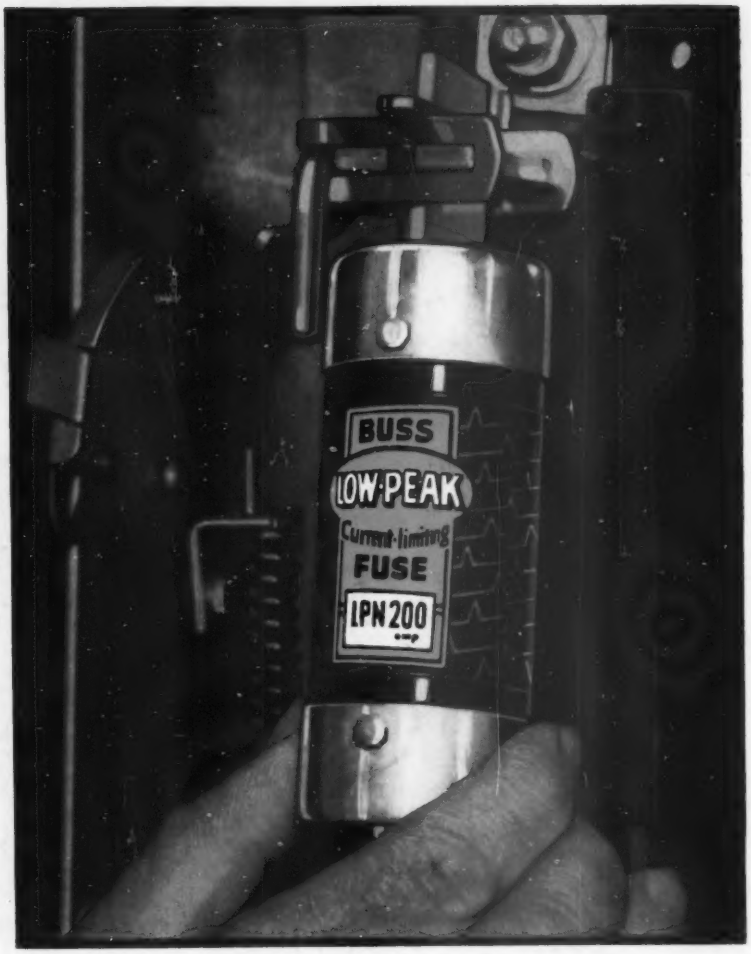

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